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Population-based evaluation of disparities in stomach cancer by nativity among Asian and Hispanic populations in California, 2011–2015

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Abstract

Background: Stomach cancer incidence presents significant racial/ethnic disparities among racial/ethnic minority groups in the US, particularly among Asian and Hispanic immigrant populations. However, population-based evaluation of disparities by nativity has been scarce due to the lack of nativity-specific population denominators, especially for disaggregated Asian subgroups. We examined population-based stomach cancer incidence and tumor characteristics by detailed race/ethnicity and nativity.

Methods: We calculated annual age-adjusted incidence rates (AAIRs) by race/ethnicity, sex, and nativity and evaluated tumor characteristics such as stage and anatomic subsite, using the 2011–2015 California Cancer Registry data. For Hispanic and Asian populations, we estimated nativity-specific population counts using the US Census and the American Community Survey Public Use Microdata Sample data.

Results: During 2011–2015 in California, 14,198 patients were diagnosed with stomach cancer. AAIRs were higher among foreign-born individuals than their US-born counterparts. The difference was modest among Hispanics (~1.3 fold) but larger (~2 to 3-fold) among Chinese, Japanese, and Korean Americans. The highest incidence was observed for foreign-born Korean and Japanese Americans (33 and 33 per 100,000 for men; 15 and 12 per 100,000 for women, respectively). The proportion of localized stage disease was highest among foreign-born Korean Americans (44%); a similar proportion was observed among US-born Korean Americans although numbers were limited. For other Asians and Hispanics, the localized stage proportion was

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generally lower among foreign-born than US-born individuals, and lowest among foreign-born Japanese Americans (23%).

Conclusions: Nativity-specific investigation with disaggregated racial/ethnic groups identified substantial stomach cancer disparities among foreign-born immigrant populations.

Precis:

Substantial racial/ethnic disparities in stomach cancer exist in the US, with the largest disparities found for foreign-born Korean and Japanese Americans. Comparisons of incidence rates and stage distribution underscore the importance of implementing targeted prevention and screening strategies for high-risk racial/ethnic subgroups and immigrant populations in the US.

Keywords

Gastric cancer; stomach cancer; cancer disparity; first-generation; immigrants; Asian American; Hispanic

Introduction

Stomach cancer is the fifth most common cancer and the third leading cause of cancer deaths worldwide (1). The incidence pattern presents substantial variation across countries, with the highest incidence reported in East Asian countries, followed by Eastern Europe and South American regions (1). In the United States (US), the estimated incidence in 2018 was 7.0 per 100,000 in 2018, and stomach cancer is no longer considered a common cancer (2). However, population-based analyses have consistently demonstrated disparities in racial/ethnic minority populations including non-Hispanic Black (NHB), American Indian/Alaska Native (AI/AN), Hispanic, and Asian Americans (2–4) with particularly elevated risks observed among Korean Americans, Japanese Americans, and Vietnamese Americans (5–8). When evaluating tumor anatomic subsite (cardia vs. non-cardia), the majority of the stomach cancer among these minority populations were non-cardia gastric cancers (5, 6), which is strongly associated with *Helicobacter pylori* (*H. pylori*), an established gastric carcinogen (9, 10).

Population-based studies in the 1970's and 1980's have reported a marked difference in stomach cancer incidence among Japanese Americans by nativity, with a substantially higher incidence in the first-generation immigrants (born in Japan) than in subsequent generations (born in the US) (11, 12). In contrast, the difference by nativity was minimal among Filipino Americans and modest in Hispanics (12, 13).

With increasing awareness of cancer disparities, primary and secondary prevention strategies for stomach cancer targeting high-risk US sub-populations are gaining more attention (5, 14–22). Countries where gastric cancer is highly prevalent, such as Korea and Japan, have established national stomach cancer screening programs for earlier detection and intervention (23, 24). The most recent US guidelines recognize high-risk sub-populations, defined by racial/ethnic differences and nativity, and benefits of targeted screening and surveillance (15, 16, 18, 20–22). However, to our knowledge, nativity-specific racial/ethnic incidence data have not been updated since 1986 (for Asian Americans) (12) or 2004

(for Hispanics) (13). California is home of the largest number of first-generation Asian and Hispanic immigrants in the US (25), and has the largest number of stomach cancer diagnoses and deaths each year amongst all US states (26). To better inform prevention strategies in high-risk immigrant populations and to identify subpopulations at an increased risk, here we report updated estimates of nativity-specific stomach cancer incidence and tumor characteristics in these largely immigrant populations (Asian and Hispanic Americans) using the data from the California Cancer Registry (CCR) 2011–2015. We also report findings on NHB and NHW populations.

Methods

Cancer incidence data:

We used the population-based California Cancer Registry (CCR) data to identify primary invasive stomach cancer cases diagnosed during 2011–2015 using the International Classification of Diseases for Oncology, 3rd edition (ICD-O-3) site codes C16.0-C16.9, histology codes 8000–8999 (13). Included in this analysis were 6,092 non-Hispanic whites (NHW), 1,076 non-Hispanic blacks (NHB), 4,630 Hispanics, and 2,337 Asian Americans diagnosed between 2011–2015. We limited the Asian American group to five subgroups that had at least 100 male and 100 female stomach cancer case patients: Chinese, Filipina, Japanese, Vietnamese, and Korean Americans.

Classification of nativity:

Asian and Hispanic stomach cancer patients were classified into US-born and foreign-born using an approach similar to the methods reported previously for CCR patients with stomach, lung, breast, and cervical cancer (13, 27–29). In brief, information on birth country was obtained from the CCR data (68% for Asian Americans and 60% for Hispanics) and supplemented from the death certificate (15% for Asian Americans and 21% for Hispanics). The remaining missing birthplace information was imputed using a validated method based on the year when the social security number (SSN) was first issued for patients whose SSN was issued before 2010 (27, 28). Until 2010, the first 5 digits of SSN contained information on the year of SSN issuance. Patients whose SSN was issued before age 20 (for Hispanics) or 25 (for Asian Americans) were considered to be US-born; patients whose SSN was issued at or after age 20 were considered foreign-born. In a prior study, these age cut-off points maximized the area under the receiver-operating characteristics curve in Hispanics and Asian Americans when utilizing self-reported nativity as the gold-standard. These cut-off points resulted in 81% and 84% sensitivity in detecting foreign-born patients for Hispanics and Asian Americans respectively, and 80% specificity for both groups (27, 28). The SSN-based imputation classified nativity for 15% of Asian American and 15% of Hispanic stomach cancer patients in our study. Overall, about 98% of Asian American and 96% of Hispanic stomach cancer patients were categorized by nativity status as foreign-born or US-born.

Population Estimates:

We used the annual population estimates for NHWs, NHBs, and Hispanics in California provided in the 1990–2018 National Cancer Institute (NCI) SEER*Stat software package

(30). Because Hispanics in the CCR data (i.e., case patients) did not include Asian/Pacific Islanders or American Indian/Alaska Natives, our population estimates for Hispanics excluded these two racial groups. Annual population estimates for each of the 5 disaggregated Asian ethnic group was estimated using the population counts from the 2000 and 2010 population censuses for California. Due to the multi-racial scheme used in the 2000 and 2010 census, population counts for each Asian subgroup by age and sex were represented by the simple average between the count for one race alone and the count for one race alone or two or more races for each sex-age-ethnicity-specific combination in each census year respectively. For all racial/ethnic subgroups, annual population estimates for each subgroup in California during 2011–2015 were obtained by extrapolation of the linear trend of sex-age-specific population changes between 2000 and 2010 for each racial/ethnic (sub)group.

Nativity-specific population estimates:

Birthplace information was not collected in the 2010 census. Instead, the American Community Survey (ACS) Public Use Microdata Sample (PUMS) provides information on birthplace (31). Therefore, we estimated nativity-specific population counts using the nativity data (foreign-born, US-born) included in the 2015 ACS PUMS 5-year estimate file (2011–2015). For Hispanics, we calculated the percentage of foreign-born individuals in California by sex and 5-year age group (e.g., age 0–4, 5–9, 10–14, etc., up to 85), and applied these percentages to the 2011–2015 sex-age-specific Hispanic population counts, in order to calculate the nativity-sex-age-specific Hispanic population counts. For Asian subgroups, the proportion of US-born individuals was much higher for Asians of mixed racial/ethnic groups than Asians of a single racial/ethnic group. Thus, the percentage of foreign-born individuals in each sex and age stratum of each Asian subgroup was calculated as the weighted average of the percentages foreign-born among single race-ethnic groups and the same percentages among mixed racial/ethnic groups based on the proportion of those of single versus mixed racial ethnic group(s), in each sex and age stratum. We then applied these percentages (i.e., % foreign born and % US-born) to the 2011–2015 sex-age-specific population counts for each Asian subgroup in California to calculate nativity-sex-age-specific Asian subgroup population counts.

Tumor characteristics:

Stomach cancer patients were further classified by stage and anatomic subsite. Tumor stage was grouped into localized, regional and distant according to the Surveillance, Epidemiology, and End Results Program (SEER) Summary Stage 2000 definition (32). Tumor subsite was categorized into cardia (C16.0), non-cardia (C16.1 - C16.6) and unknown, which includes overlapping or unspecified (C16.8, C16.9). The overlapping subsite code (C16.8) indicates not only an overlap between cardia and non-cardia sites but also an overlap between two or more non-cardia subsites. Because the overlapping subsite code was noted for only ~10% of cases across racial/ethnic groups and does not necessarily indicate cardia and non-cardia overlap, we combined overlapping and unspecified sites together. This classification method was used in prior studies (5, 6). The main findings of our study did not change when separating overlapping (C16.8) and unspecified (C16.9) subsites.

Statistical Methods:

The annual age-adjusted incidence rates (AAIRs) per 100,000 population were calculated by direct standardization to the 2000 U.S standard population for the time period of 2011–2015, by sex, race/ethnicity, and for Hispanics and Asian subgroups, nativity. We also examined distribution of tumor stage and anatomic subsite (cardia vs. non-cardia) by race/ethnicity and nativity. To comply with the data suppression rules for small numbers of the CCR, numbers of cancer diagnoses that are less than 11 and relevant AAIRs are not presented. We also calculated 95% confidence intervals for the incidence rate ratios (33).

Results

About half of the stomach cancer patients included in the study were Hispanic or Asian Americans (Table 1). Among Hispanic and Asian American patients, nearly half (45%) of Japanese and 30% of Hispanic patients were US-born, whereas <10% of other Asian patients (Chinese, Filipino, Korean, and Vietnamese) were US-born (Table 1, row % not presented). Neighborhood socio-economic status (SES) and age at diagnosis were similar between US-born and foreign-born patients, but the proportion of lowest SES was slightly higher among foreign-born than US-born individuals and the proportion of youngest age at diagnosis (< 39) was slightly higher among US-born individuals.

Stomach cancer incidence displayed substantial disparities across racial/ethnic groups in both men and women (Figure 1 and Supplementary Table 1). All racial/ethnic minority populations including NHB, Hispanic, and all Asian subgroups except Filipinos showed higher stomach cancer incidence than NHWs with rate ratios ranging from 1.53 to 4.06 (vs. NHW) in men and from 2.07 to 4.41 in women. When stratifying Hispanics and Asian subgroups by nativity, all foreign-born subgroups, except Filipino Americans, showed higher incidence than NHW. The highest incidence was observed for foreign-born Korean American men (32.5 per 100,000) and Japanese American men (32.6 per 100,000), about 4.2 times higher than the incidence in NHW men (7.8 per 100,000). Foreign-born Vietnamese American, Hispanic, and Chinese American men also experienced increased incidence rates, ranging from 12.9 to 14.3 per 100,000, which was 65% to 83% higher than NHWs. The incidence rates among foreign-born immigrant populations were also higher when compared with their US-born counterparts, by 37% for Hispanics and by ~2 to >3 fold for Chinese and Japanese Americans. It is notable that the incidence rates in US-born Japanese and Hispanic men were still ~30% higher than the incidence in NHW men even though these rates are not as high as their foreign-born counterparts. Furthermore, it is also notable that the incidence among NHB men was comparable to the rates among foreign-born Hispanic and Chinese men. A similar pattern was observed among women: foreign-born Korean and Japanese American women experienced the highest incidence rates (15.4 and 11.9 per 100,000, respectively; 4.4 and 3.4 times higher than that in NHWs) followed by foreign-born Vietnamese American, Hispanic, and Chinese American women (ranging from 8.0 to 9.8 per 100,000; 2.3 to 2.8 times higher than that in NHWs). The rate in US-born Hispanic women was also elevated (7.0 per 100,000; 2.1 times higher than NHWs). However, the incidence in US-born Japanese American women was similar to the rate in NHW women.

We observed substantial disparities not only in the incidence but also in the stage at diagnosis of stomach cancer in foreign-born immigrant populations (Figure 2). The percentage of localized stage disease for foreign-born individuals was lower compared to their US-born counterparts for nearly all immigrant populations (Hispanic, Japanese, Chinese, and Filipino Americans; data for US-born Chinese and Filipinos are suppressed). In particular, foreign-born Japanese and Filipino Americans showed the lowest percentages of localized disease (23–24%) across all population subgroups. Interestingly, the percentage of localized stage tumor among foreign-born Korean Americans was 44%, substantially higher than the percentages in all other subgroups, ranging between 23% and 34%. Stage distribution among foreign-born vs. US-born Korean Americans appeared to be similar (data for US-born Koreans are suppressed), however, the total number of US-born Korean Americans with stomach cancer was limited.

Anatomic subsite distribution showed substantial differences by sex (Figure 3). Across all race/ethnicity, men had a higher proportion of cardia stomach cancer than women. Among men, the percentage of cardia subsite was highest among NHWs (52%) followed by foreign-born Filipinos (33%) and lowest among foreign-born Korean and Vietnamese Americans. For Hispanics and Japanese American men, for whom subsite distribution was calculated for both foreign-born and US-born individuals, the percentage of cardia site was higher among US-born individuals than foreign-born individuals. Among women, percentage of cardia site was highest among NHWs (25%) and similarly low for all other groups (5–11%).

Discussion

To our knowledge, this is the first population-based investigation of nativity-specific stomach cancer incidence rates for the five Asian American subgroups and Hispanics in California, updating the previous nativity-specific estimates up to 1986 for three Asian American subgroups (Japanese, Filipino, and Chinese) (12) and up to 2004 for Hispanics (13). Our analysis of the CCR 2011–2015 data indicates that first-generation Asian and Hispanic immigrants and NHBs had higher risk of stomach cancer compared to NHWs, with the highest risk observed among foreign-born Korean and Japanese Americans. While US-born individuals of these Asian American subgroups and Hispanic were at lower risk than their foreign-born counterparts, certain US-born individuals (Hispanic men and women and Japanese men) were still at higher risk than NHW. Despite the higher stomach cancer incidence, early detection rates in foreign-born immigrants were lower than the rates in their US-born counterparts, except for foreign-born Korean Americans, which showed the highest early detection rate of all racial/ethnic sub-populations.

Consistent with earlier reports (11–13), our updated analysis confirms that the incidence of stomach cancer is higher among racial/ethnic minority populations and in first-generation (foreign-born) immigrants than their US-born counterparts. Our findings are reflective of the internationally highest incidence reported from South Korea and Japan (1), nearly 10-fold higher than the US (5, 34). The difference is likely to be largely attributable to the difference in prevalence of *H. pylori*, an established gastric carcinogen (9), across racial/ethnic groups and across countries. In a meta-analysis, *H. pylori* prevalence in the US (36%) was much lower than in the countries where these high-risk immigrants came from (52% to 56% in

Mexico and east Asian countries such as China, Japan, Korea, Taiwan) (35). The *H. pylori* prevalence in the 1999–2000 National Health and Nutrition Examination Survey (NHANES) in the US was higher in NHB (52%) and Mexican Americans (64%) compared to NHWs (21%) (36). Among Hispanics in California (mainly children; median age <10), prevalence of *H. pylori* decreased in successive immigration generations: the age-adjusted odds of *H. pylori* infection among US-born Hispanics was much lower than that among foreign-born Hispanics (nearly one half among US-born Hispanics whose parent(s) were born in Latin America and nearly one tenth among US-born Hispanics whose parents were all born in the US) (37). However, the modest decline in stomach cancer incidence among US-born Hispanics compared to foreign-born Hispanics in our analysis warrants a comprehensive evaluation of risk factor profiles in foreign-born as well as US-born Hispanics.

Our finding that US-born subgroups (e.g., Hispanics, Japanese, Chinese, Filipino Americans) were diagnosed at an earlier stage than foreign-born counterparts parallels the later cancer detection among foreign-born (vs. US-born) immigrants for many cancer types including breast (38), cervical (39), and colorectal (40) cancer. These cancer detection disparities in foreign-born immigrant populations are particularly critical for stomach cancer due to the higher incidence in these foreign-born immigrant populations. The exceptionally high early detection rate for Korean Americans compared to all other subgroups (44% vs. 23–34% localized stage) we observed is consistent with earlier reports from our group (5) and others (41–43), and likely to be due to earlier use of upper endoscopy among foreign-born Korean American patients. In an analysis of Medicare claims data for Asian American stomach cancer patients diagnosed between 2004–2013, pre-diagnosis (i.e., >18 months before diagnosis) history of upper gastrointestinal endoscopy was remarkably more prevalent among Korean American stomach cancer patients compared to other Asian American stomach cancer patients (~43% vs. ~20%) (42). In South Korea, bi-annual stomach cancer screening is offered for adults aged 40 through a population-based screening program and health care providers (44), and ~66% of stomach cancers are diagnosed at localized stage (45), indicating that the relatively earlier detection of stomach cancer among Korean Americans is still sub-optimal for this high risk population. Similar to South Korea, the early detection rate is high in Japan (56% of stomach cancer are diagnosed at localized stage) (46) due to a national stomach cancer screening program and opportunistic endoscopic screening (23). Thus, our finding of the substantially lower percentage of localized disease among foreign-born Japanese than foreign-born Korean Americans is unexpected and warrants further investigation.

About 86% of adults aged 40–74 in Korea had a lifetime history of stomach cancer screening in 2018 in a nationwide survey (24); the majority (85%) of them were adherent to bi-annual screening, predominantly (89%) through upper endoscopy. In contrast, stomach cancer screening is generally not recommended in the US, even for high-risk populations (47). However, the most recent guidelines from the American Society for Gastrointestinal Endoscopy recommend that screening endoscopy for stomach cancer “may be considered in new US immigrants from high-risk regions around the world including Korea, Japan, China, Russia, and South America, especially if there is a family history of gastric cancer in a first-degree relative.” (19). The consensus statement from the 2020 Gastric Cancer Summit at Stanford University also recommended that endoscopic screening beginning at

age 50 should be offered in the US to first-generation immigrants from high-risk regions or racial/ethnic groups with increased risk (20). Insurance coverage of such targeted screening endoscopy and developing strategies to increase patient and provider awareness warrants further discussion.

Stomach cancer in the cardia is thought to have a different etiology than non-cardia stomach cancer. Important risk factors for cardia cancer are obesity and reflux disease (10). *H. pylori* infection is not a risk factor for cardia cancer in western countries and the association in high-risk populations is weaker than for non-cardia site (10, 48). As our group and others have shown previously (5, 49), the proportion of cardia cancer was higher among men than in women across all racial/ethnic groups and highest in NHW men. The lower proportions of cardia stomach cancer among foreign-born Korean Americans and foreign-born Japanese Americans are consistent with the proportions in East Asian countries including Korea (6% in men and 5% in women) and Japan (11% in men and 8% in women) (50). These observations could be at least partially explained by the lower prevalence of obesity and gastroesophageal reflux disease among Asians than in western populations (51, 52) and the higher prevalence of erosive esophagitis, a reflux-related disease in men than in women, and in NHWs than in NHB and Hispanics (53, 54). Furthermore, the higher proportion of cardia subsite among the US-born vs. foreign-born immigrants for Hispanic and Japanese American men may indicate that stomach cancer tumor characteristics in successive immigrant generations become similar to those of NHWs.

The strengths of the current study include the nativity-specific evaluation of stomach cancer disparities across racial/ethnic groups using the population-based CCR data. The limitations include the limited sample sizes for US-born Asian subgroups, precluding nativity-specific estimates for some of the more recent immigrant populations; potential misclassification of race and ethnicity of cancer cases in the CCR database, which are primarily derived from medical records; and potential errors in population estimates derived from the Census data and the ACS data (7). These limitations would occur as in any studies based on the US cancer registries data. Additional limitations include that more recent CCR data (2016–2020) were not included in the analysis; AI/AN who are at ~2-fold elevated risk than NHW (2, 4) were not included due to the small numbers; nativity-specific incidence among NHW and NHB were not evaluated. Analysis of US mortality database indicate that foreign-born NHWs have a 2-fold elevated stomach cancer mortality than US-born NHWs (55), in line with the >3–4 fold higher incidence in certain Central and Eastern European countries compared to the incidence in the US (56, 57). In contrast, foreign-born and US-born NHBs have similar stomach cancer mortality (55). Future work to address nativity-specific incidence among NHW and NHB will be crucial to identify sub-populations who would benefit from risk-based healthcare to prevent stomach cancer and improve early detection.

Conclusions

In conclusion, our results show substantial racial/ethnic disparities in stomach cancer incidence in the US, with the largest disparities found for foreign-born Korean and Japanese Americans. Comparisons of incidence rates and stage distribution underscore the importance

of implementing targeted prevention and screening strategies for high-risk racial/ethnic subgroups and immigrant populations in the US.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data availability:

The incidence data used for this research is available through the California Cancer Registry (CCR) (<https://www.ccrca.org/retrieve-data>). A number of CCR data variables derived from death certificates are not publicly available.

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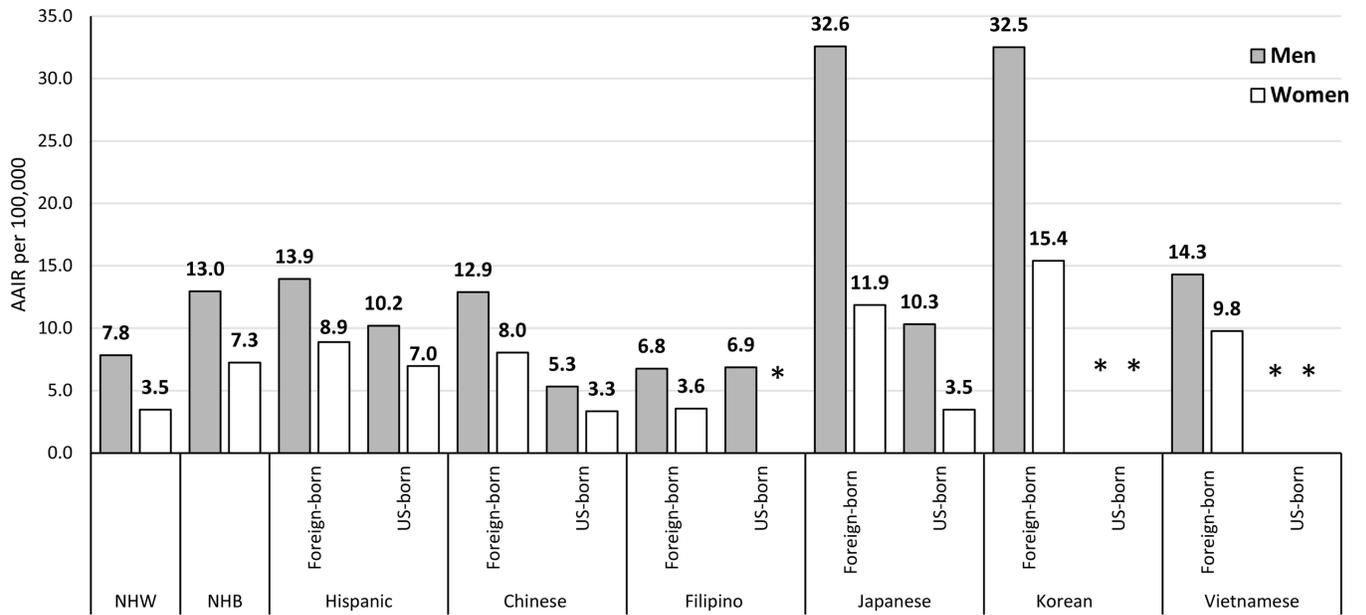


Figure 1.
 Age-adjusted incidence rates (AAIRs) of stomach cancer by race/ethnicity and nativity, California, 2011–2015.
 Abbreviations: NHW, non-Hispanic whites, NHB, non-Hispanic Black
 * Not presented due to small cell suppression policy of the California Cancer Registry

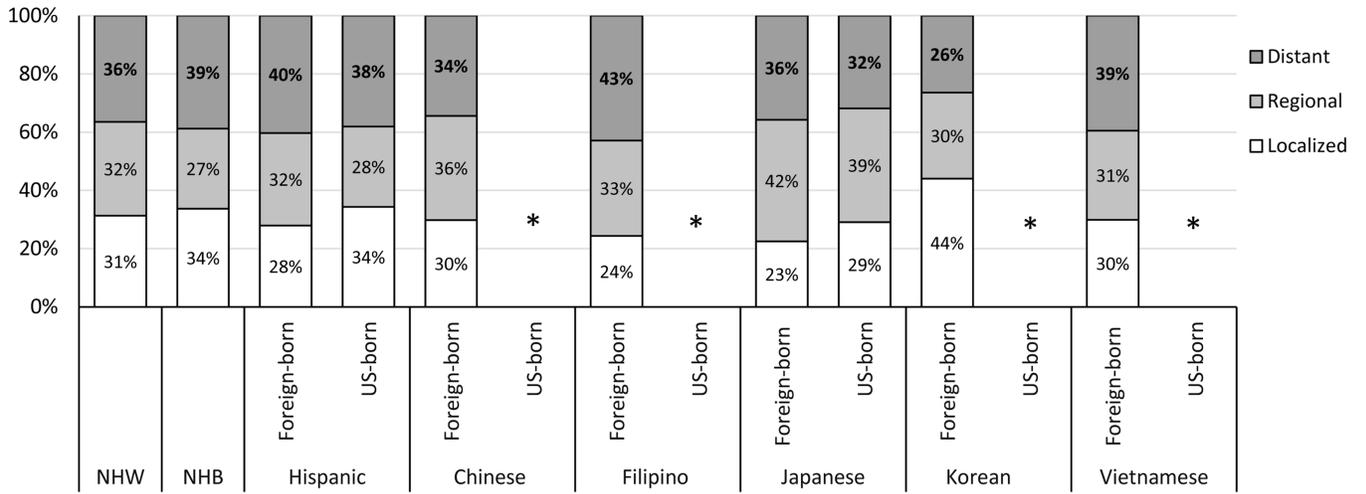


Figure 2. Stage distribution by race/ethnicity and nativity among staged patients, California, 2011–2015

Abbreviations: NHW, non-Hispanic whites, NHB, non-Hispanic Black

* Not presented due to small cell suppression policy of the California Cancer Registry.

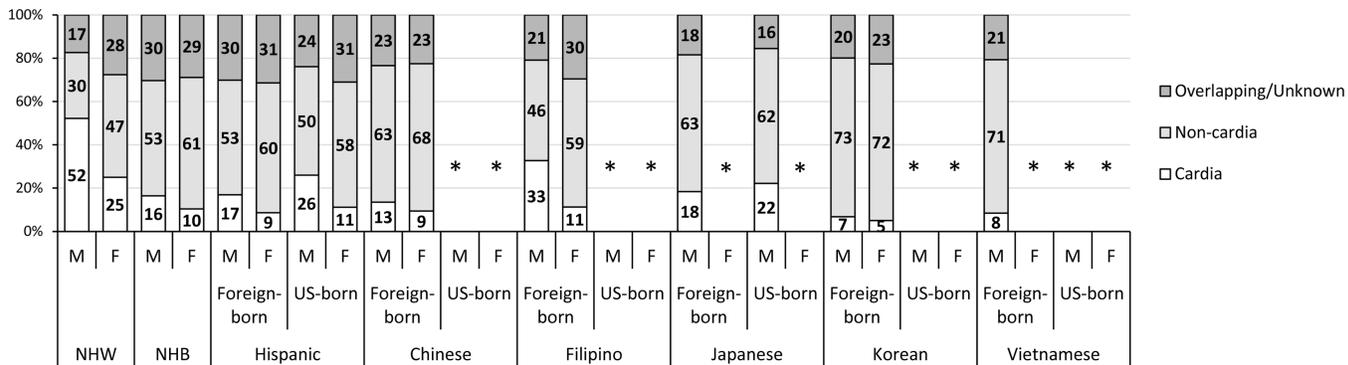


Figure 3.
 Tumor subsite distribution by sex, race/ethnicity and nativity, California, 2011–2015
 Abbreviations: M, male, F, Female, NHW, non-Hispanic whites, NHB, non-Hispanic Black
 * Not presented due to small cell suppression policy of the California Cancer Registry

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Table 1.

Demographic characteristics of the stomach cancer patients

	All participants		By nativity among Hispanic and Asian Americans					
			All		Foreign-born		US-born	
	N	%	N	%	N	%	N	%
Sex								
Male	8564	60%	3780	56%	2927	56%	853	55%
Female	5634	40%	3004	44%	2300	44%	704	45%
Race/ethnicity								
Non-Hispanic White	6092	43%	-	-	-	-	-	-
Non-Hispanic Black	1076	8%	-	-	-	-	-	-
Hispanic	4630	33%	4447	66%	3120	60%	1327	85%
Chinese	810	6%	783	12%	743	14%	40	3%
Filipino	354	2%	339	5%	310	6%	29	2%
Korean	570	4%	566	8%	554	11%	12	1%
Japanese	316	2%	310	5%	172	3%	138	9%
Vietnamese	350	2%	339	5%	328	6%	11	1%
Neighborhood SES								
Lowest	2913	21%	1909	28%	1515	29%	394	25%
Lower-Middle	3076	22%	1674	25%	1282	25%	392	25%
Middle	2887	20%	1288	19%	964	18%	324	21%
Upper-Middle	2876	20%	1108	16%	840	16%	268	17%
Highest	2446	17%	805	12%	626	12%	179	11%
Age								
39	536	4%	384	6%	238	5%	146	9%
40–59	3504	25%	1964	29%	1545	30%	419	27%
60–69	3448	24%	1513	22%	1198	23%	315	20%
70–79	3537	25%	1548	23%	1228	23%	320	21%
80	3173	22%	1375	20%	1018	19%	357	23%