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Colorectal Cancer Incidence in Asian Populations in California: Effect of Nativity and Neighborhood-Level Factors

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Abstract

OBJECTIVES—Heritable and environmental factors may contribute to differences in colorectal cancer (CRC) incidence across populations. We capitalized on the resources of the California Cancer Registry (CCR) and California's diverse Asian population to perform a cohort study exploring the relationships between CRC incidence, nativity, and neighborhood-level factors across Asian subgroups.

METHODS—We identified CRC cases in the CCR from 1990 to 2004 and calculated age-adjusted CRC incidence rates for non-Hispanic Whites and US-born vs. foreign-born Asian ethnic subgroups, stratified by neighborhood socioeconomic status (SES) and "ethnic enclave." Trends were studied with joinpoint analysis.

RESULTS—CRC incidence was lowest among foreign-born South Asians (22.0/100,000; 95% confidence interval (CI): 19.7–24.5/100,000) and highest among foreign-born Japanese (74.6/100,000; 95% CI: 70.1–79.2/100,000). Women in all Asian subgroups except Japanese, and men in all Asian subgroups except Japanese and US-born Chinese, had lower CRC incidence than non-Hispanic Whites. Among Chinese men and Filipino women and men, CRC incidence was lower among foreign-born than US-born persons; the opposite was observed for Japanese women and men. Among non-Hispanic Whites, but not most Asian subgroups, CRC incidence decreased

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over time. CRC incidence was inversely associated with neighborhood SES among non-Hispanic Whites, and level of ethnic enclave among Asians.

CONCLUSIONS—CRC incidence rates differ substantially across Asian subgroups in California. The significant associations between CRC incidence and nativity and residence in an ethnic enclave suggest a substantial effect of acquired environmental factors. The absence of declines in CRC incidence rates among most Asians during our study period may point to disparities in screening compared with Whites.

INTRODUCTION

Colorectal cancer (CRC) incidence varies between countries and subpopulations within countries (1–3). Heritable and environmental factors may each account for some of these differences (4). Screening substantially decreases CRC incidence and mortality (5–9), and probably has contributed to recent decreases in US CRC incidence (4,10,11).

Persons of Asian ancestry in the United States are a heterogenous population, representing many countries of origin, birthplace in Asia or the United States, and varying degrees of acculturation to a “Western” lifestyle (12,13). Epidemiological analyses that consider Asians as a single group may obscure important differences between subgroups (14). Studies of immigrants, including studies of CRC risk in Japanese compared with Japanese immigrants and their descendants in Hawaii and California (15–17), represent classic epidemiological studies of the environment’s impact on cancer risk. The large and diverse Asian population in California and the resources of the California Cancer Registry (CCR) (18–22) provide a unique opportunity to further examine the relative burden of CRC in Asian American subpopulations, and the possible role of environmental factors.

We examined differences in CRC incidence, tumor characteristics, and trends over time among the major Asian subgroups in California and evaluated the impact of nativity, neighborhood socioeconomic status (SES), and residence on an ethnic enclave (19–22). We hypothesized that lower CRC incidence rates would be observed among foreign-born Asians vs. US-born Asians, and among those living in ethnic enclaves, where Western lifestyles might be less prevalent vs. those living in the least ethnic neighborhoods.

METHODS

CRC incidence data

CRC cases were identified using the CCR (18), which comprise four National Cancer Institute SEER (Surveillance, Epidemiology, and End Results) program registries (23). We obtained information on all California residents diagnosed with a primary invasive colon or rectal cancer (International Classification of Disease for Oncology, 3rd Edition, C180–189, C260, C199, C209, and excluding histologies 9,590–9,989, 9,050–9,055, and 9,140) from 1 January 1990 through 31 December 2004. At the time of analysis, the required Census 2010 data by ethnicity and nativity were not available to produce population estimates beyond 2004. Tumor location was categorized as proximal colon, distal colon, rectum, or other. Our cohort includes 16,159 Asians (5,645 Chinese, 3,506 Japanese, 3,921 Filipino, 1,389 Korean, 453 South Asian (including Asian Indian, Pakistani, Sri Lankan, and Bangladeshi),

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and 1,244 Vietnamese), and 153,804 non-Hispanic Whites as a comparison group. These six Asian ethnic populations comprised 92.5% of all Asian and Pacific Islander patients with CRC in the CCR in 1990–2004.

Nativity data

Registry-based birthplace data were available for 83% of cases (69% from hospital records; 14% from death certificates). As Asian patients in the CCR with unknown birthplace are more likely to be US born (24,25), we applied our previously validated statistical imputation method (14) based on Social Security numbers (SSN) to classify nativity into US born or foreign born. This method considers cases who received a SSN before the age of 25 years as US born, and the rest as foreign born, resulting in 84% sensitivity and 80 % specificity across each Asian population (14). We used this approach for 16% of cases with unknown birthplace. The 1% of cases with missing or invalid SSNs were randomly assigned an immigrant status based on the overall sample's ethnicity-sex-age-birthplace distribution. The numbers of US-born South Asian (45), Vietnamese (44), and Korean (54) cases were too small for analyses.

Population data for cancer rate denominators

From the 1990 and 2000 Census Summary File 3, we obtained population counts by sex, race/ethnicity, immigrant status, and 5-year age group for California. We used the 5% Integrated Public Use Microdata Sample of the Census to estimate age- and birthplace-specific population counts for the six Asian groups (26–29) by smoothing with a spline-based function (30). For intercensal years, we estimated the percent foreign-born using cohort component interpolation and extrapolation methods (31), adjusting estimates to the populations by age and year provided by the US Census for 1990–2004.

Incidence rates by neighborhood socioeconomic and ethnic enclave status

Using patient residential address and small area (census tract) information from the US Census, we classified neighborhood SES and ethnic enclave status (19–22) for all Asian patients diagnosed with CRC between 1 January 1998 and 31 December 2002. For these analyses, we grouped all Asians and Pacific Islanders together into a single group because detailed ethnicity-specific population estimates are not available for census tracts, and we chose 1998–2002 (i.e., within 2 years of the 2000 US Census) because census tract-level population estimates by race/ethnicity are only available for decennial census years. For CRC cases, census tracts were geocoded from residential addresses at the time of diagnoses. The 3% of cases whose address could not be precisely geocoded were randomly assigned to a census tract within their county of residence. We assigned neighborhood SES using a previously described (32) and widely used index that incorporates 2000 US Census data on education, income, occupation, and housing costs based on selection via principal components analysis. We categorized this measure by quintiles based on the distribution of the composite SES index across California. As the CCR does not collect individual-level SES information, we could not assess this separately from neighborhood-level effects.

We defined a neighborhood ethnic enclave as a geographical unit that is relatively more concentrated than other units in California with respect to population and language (here,

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specific to Asians) (21). To characterize residence in an ethnic enclave, we applied principal components analysis to selected census variables at the block group level, which was in turn averaged to the census tract level. The variables included in the ethnic enclave index were percent of Asian language-speaking households that are linguistically isolated (as defined by the Census: household in which all adults (aged 14 or older) speak an Asian language and none speaks English "very well"), percent of all Asian language speakers who speak limited English, percent of recent immigrants, and percent of Asian. This index explained 63% of the variability in the data. Neighborhood ethnic enclave was classified into quintiles based on the distribution of the composite ethnic enclave index across California.

Statistical analysis

Cancer incidence rates and 95% confidence intervals (CIs) were calculated as cases per 100,000 persons and age adjusted to the 2000 US standard population using SEER*Stat software (http://www.seer.cancer.gov/seerstat/). To comply with CCR confidentiality regulations, we do not present counts or rates based on less than five cases. We calculated incidence rates for populations defined by race/ethnicity, sex, nativity, and/or neighborhood characteristics. To compare rates between groups, we computed incidence rate ratios and their associated 95% CIs and *P* values, with exclusion of 1 in the 95% CI reflecting an incidence rate ratio that differs significantly from 1 at $P < 0.05$. As neighborhood SES and ethnic enclave status are highly correlated, we also defined census tracts jointly by SES and ethnic enclave. We could not perform joint analyses by patient-level birthplace and neighborhood SES or ethnic enclave status owing to the lack of census-tract-level population data by birthplace. Distributions of CRC cases were compared with χ^2-tests. Joinpoint regression models and annual percentage change statistics were used to characterize the magnitude, direction, and duration of trends (33). A maximum of two joinpoints were selected *a priori* based on the numbers of years of data available. All analyses had the approval of the Institutional Review Board of the Cancer Prevention Institute of California.

RESULTS

Patient demographics and tumor characteristics

The demographic and tumor characteristics of CRC patients are shown in Table 1 for non-Hispanic Whites and Asian subgroups by race/ethnicity and nativity. Proximal colon cancer was proportionally more common among non-Hispanic Whites (42.2%) than among the Asian subgroups (24.8–33.9%; $P < 0.0001$ for all pairwise comparisons). Localized CRC was proportionally more common among non-Hispanic Whites (37.3%) than among all foreign-born Asian subgroups (30.2–32.9%; $P < 0.001$ for all pairwise comparisons). In contrast, the proportions of localized CRC did not differ significantly between non-Hispanic Whites and US-born Chinese ($P = 0.18$), US-born Japanese ($P = 0.26$), and US-born Filipino ($P = 0.25$). US-born Chinese and foreign-born South Asian patients with CRC were more likely to live in the highest SES neighborhoods than non-Hispanic Whites and other Asian subgroups, whereas foreign-born Chinese, Filipino, Korean, and Vietnamese patients with CRC were more likely to live in the lowest two SES quintile neighborhoods (Table 1).

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CRC incidence

Age-adjusted incidence rates of invasive CRC differed by Asian subgroup, sex, and nativity (Table 2). Foreign-born South Asians had the lowest (22.0/100,000; 95% CI: 19.7–24.5/100,000) and foreign-born Japanese had the highest (74.6/100,000; 95% CI: 70.1–79.2/100,000) CRC incidence rates. Men had higher CRC incidence than women in all subgroups. Compared with non-Hispanic White women, women in all Asian subgroups except Japanese had lower CRC incidence. Compared with non-Hispanic White men, men in all Asian subgroups except Japanese and US-born Chinese had lower CRC incidence.

Foreign-born Chinese men had lower CRC incidence than US-born Chinese men, but there was no significant difference between foreign-born and US-born Chinese women. CRC incidence was higher in foreign-born Japanese women and men than in US-born Japanese women and men, and lower in foreign-born Filipino women and men than in US-born Filipino women and men.

Trends in CRC incidence

Among non-Hispanic White women and men, CRC incidence rates decreased significantly over time, but such decreases were not observed among most Asian subgroups (Table 3; Figures 1 and 2).

Among non-Hispanic White women, CRC incidence decreased annually by 2.1% (95% CI: 0.8–3.4%) from 1990 to 1995, did not change significantly from 1995 to 1998, and decreased annually by 2.4% (95% CI: 1.4–3.4%) from 1998 to 2004. Among non-Hispanic White men, CRC incidence decreased annually by 2.5% (95% CI: 1.3–3.7%) from 1990 to 1995, did not change significantly from 1995 to 1998, and decreased annually by 2.7% (95% CI: 1.8–3.6%) from 1998 to 2004.

The only Asian subgroups in which CRC incidence changed significantly over time were foreign-born Chinese men, in whom CRC incidence decreased annually by 1.5% (95% CI: 0.6–2.4%) from 1990 to 2004, and US-born Japanese men, in whom CRC incidence increased annually by 4.2 % (95 % CI: 0.2–8.5 %) from 1990 to 1997, and then decreased annually by 4.5% (95% CI: 1.3–7.6%) from 1997 to 2004.

Incidence patterns by neighborhood SES and ethnic enclave

Among non-Hispanic Whites, CRC incidence rate was inversely associated with census tract level SES quintile (Table 4). CRC incidence was 47.9/100,000 (95% CI: 47.1–48.8/100,000) in the highest SES quintile compared with 69.3/100,000 (95% CI: 67.4–71.2/100,000) in the lowest SES quintile (incidence rate ratio: 0.69, 95% CI: 0.67–0.71). In contrast, among Asians/Pacific Islanders, an inconsistent association was seen, with relatively lower rates among the second and lowest SES quintiles (Table 4).

Among Asians/Pacific Islanders, CRC incidence was inversely associated with census tract ethnic enclave level (Table 4). CRC incidence was 43.2/100,000 (95% CI: 41.4–44.6/100,000) in the highest ethnic enclave quintile (most ethnic) compared with 53.8/100,000 (95% CI: 46.9–61.4/100,000) in the lowest ethnic enclave quintile (least ethnic; incidence rate ratio: 0.80, 95% CI: 0.70–0.92).

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The effect of census tract level ethnic enclave was seen in higher as well as lower SES levels, but was more pronounced in the two highest SES quintiles (Table 4). CRC incidence was lowest among persons living in high SES and high ethnic enclave neighborhoods (42.7/100,000; 95% CI: 40.9–44.4/100,000), and highest among persons living in high SES and low ethnic enclave neighborhoods (53.2/100,000; 95% CI: 49.4–57.2/100,000).

DISCUSSION

We found substantial differences in CRC incidence among Asian subgroups in California, with a threefold incidence rate difference between foreign-born South Asians, who had the lowest CRC incidence, and foreign-born Japanese, who had the highest. Compared with non-Hispanic Whites, Asians were more likely to present with distal CRC, foreign-born Asians were less likely to present with localized disease, and all subgroups except Japanese and US-born Chinese men had lower CRC incidence. The relationship between CRC incidence and nativity varied among Asian subgroups. In contrast with the significant decrease in CRC incidence over time that was observed among non-Hispanic Whites during our study period, CRC incidence did not decline significantly among most Asian subgroups. The direct relationship between SES and CRC incidence that was observed among non-Hispanic Whites was not observed in Asians. Instead, among Asians, residence in an ethnic enclave was directly associated with decreased CRC incidence, and it modified the relationship with neighborhood SES.

Previous studies have shown that invasive CRC incidence rates are usually but not always higher among Asian-Americans than in Asia (34,35). This general pattern is consistent with our observation of significantly higher CRC rates among US-born Filipinos and US-born Chinese men relative to their foreign-born counterparts, but is not consistent with our observations of similar rates between US-born and foreign-born Chinese women, and higher rates among foreign-born than US-born Japanese women and men. Earlier studies of Japanese migrants to Hawaii have shown higher CRC incidence rates among first- and second-generation migrants than among Japanese in Japan (16). First-generation Japanese migrants quickly reached the high incidence rates of CRC among Whites in Hawaii, indicating environmental risk factors may operate later in life (16). Our findings confirm past observations of substantially higher rates in foreign-born Japanese than Non-Hispanic Whites (74.6 vs. 52.8 per 100,000, respectively, in our study). Our results are in line with those of some (16) but not all (34) previous studies. In the latter study, unknown birthplace was imputed assuming the distribution for cases with known birthplace, which may bias the estimates. To lend additional perspective to our findings, invasive CRC incidence rates among African-Americans in California from 1990 to 2004 were higher than for most Asian subgroups (71.5 per 100,000 among men, and 55.4 per 100,000 among women) (36).

Acculturation generally results in higher prevalence of CRC risk factors, such as obesity and physical inactivity (12,13), and increased intake of red and processed meats and refined grains, and decreased intake of fruits, vegetables, and whole grains (37). However, screening also affects CRC incidence, and the interaction between the increased potential exposure to risk factors as well as screening upon immigration to the United States is likely to be complex. Among Asians, neighborhood characteristics, including SES and ethnic enclave

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status (as a measure of acculturation) may affect CRC incidence through housing density, built environment for physical activity, access to health care and cancer screening, food environment and diet, and cultural and community attitudes, and social norms about risk factors such as obesity (38–41).

In the United States, overall CRC incidence has been declining, consistent with our observations among non-Hispanic Whites in California. These declines may be attributable in part to screening (4,10,11). Some Asian groups are less likely to undergo screening, with barriers attributable to language, cultural, and access factors (42–47). One might hypothesize that the absence of declines in CRC incidence among most Asian groups in California during our study period may relate in part to relatively low screening uptake. A recent study focusing on the period 1988–2007 in California found decreases in CRC incidence over time among some Asian subgroups, but increases among others (48). The apparent higher prevalence of proximal CRC in non-Hispanic Whites compared with Asians might reflect a preferential reduction in distal CRC attributable to screening in non-Hispanic Whites (7–9,49,50).

We are not aware of previous studies examining differences in CRC incidence with respect to nativity, SES, and residence in ethnic enclaves among Asians in the United States. For other cancers, differences related to nativity vary across Asian ethnic groups, as we observed here for CRC, and cancer incidence tends to track with lower SES and lower ethnic enclave neighborhoods (19–22). We have observed higher breast cancer rates among US-born compared with foreign-born Chinese and Filipino women, but similar rates between US-born and foreign-born Japanese women, which may reflect relatively recent changes in risk factors in Japan, as well as high levels of acculturation among foreign-born Japanese-Americans, who tend to have lived longer in the United States than other foreign-born Asian-Americans (14,27,51–53). As with breast cancer, our results for CRC among Japanese differed from the incidence patterns for most other Asian-American subgroups. CRC rates in Japanese-Americans suggest possible interactions between biological and environmental factors, given that CRC rates in Japanese migrants to the United States surpass those of Whites in a single generation (54).

Our analysis has notable strengths. It is based on 16 years of high-quality population-based cancer registry data from California, which includes more than half of the SEER Asian population (52), enhanced with the capability to examine rates by nativity and neighborhood characteristics. We capitalized on this large Asian-American population in California. We consider the ethnic and birthplace classifications to have low probabilities of misclassification or bias. Specifically, Asian ethnic group classification is coded directly from registry records (usually medical records) in most cases or by applying a validated algorithm (55). Cancer registry classification of specific Asian ethnicity shows good agreement with self-report (56). We have demonstrated that the completeness of registry information on birthplace is biased, with US-born more likely to be listed as unknown (24,25); thus, prior results that impute nativity based on a proportional distribution should be interpreted with caution (34). For cases with birthplace information reported to the registry (the vast majority), we have demonstrated that for Asians this shows excellent agreement

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with self-report (24,57); for the remaining cases, we applied a validated algorithm with good sensitivity and specificity.

Our study has limitations. The sample sizes for US-born Koreans, Vietnamese, and South Asians were too small to be analyzed. Small case and denominator counts in other subgroups may have resulted in unstable rates and limited our ability to detect significant trends, as evidenced by some wide CIs for some annual percentage changes, such as the results for US-born Filipinos. Cancer registry data lack detail regarding potentially important clinical information, such as tumor markers, parental race/ethnicity, and individual-level education; other measures of SES, screening, and medical history; and other potential risk factors. The potential misclassifications with the nativity assignment algorithm could have affected our results, but given that the algorithm was applied to only 16% of the cases, it is unlikely to have affected our conclusions. It would be informative to examine cancer incidence in foreign-born Japanese stratified by time of residence in the United States in order to gain insight into the timing of acquired risk. Unfortunately, data on time of residence are not available. However, we have looked at the age at issue of the SSN, which may be a reasonable proxy of age at immigration. The mean sex-specific ages at issuance of SSN among foreign-born Japanese were 9–16 years younger than those of other foreign-born Asian groups, suggesting that the foreign-born Japanese immigrated earlier in life, and thus may be more acculturated than other foreign-born Asians. Finally, there may be errors associated with the inter- and post-censal annual population estimates, which is a concern for the extrapolated estimates after year 2000 (58). Therefore, we limited our trend assessment through 2004.

In conclusion, we observed substantial differences in CRC incidence rates across Asian-American subgroups. The significant impacts of nativity and residence in an ethnic enclave on CRC incidence suggest a substantial effect of acquired environmental factors. Disparities in screening rates in Asians compared with non-Hispanic Whites in the United States may explain, in part, the absence of declines in CRC incidence rates among most Asians during our study period, the higher prevalence of distal CRC among Asians, and the lower prevalence of localized CRC among foreign-born Asians. It remains to be determined whether our findings can inform tailored CRC control strategies in specific populations.

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Study Highlights

WHAT IS CURRENT KNOWLEDGE

- ✓ Heritable and environmental factors contribute to differences in colorectal cancer (CRC) incidence between countries and subpopulations.
- ✓ Persons of Asian ancestry in the United States are a heterogenous population.
- ✓ Few subgroup-specific data are available on CRC incidence and mortality among foreign-born and US-born persons of Asian ancestry in the United States.

WHAT IS NEW HERE

- ✓ There are substantial differences in CRC incidence among Asian subgroups in California, with a threefold higher CRC incidence in foreign-born Japanese than in foreign-born South Asians.
- ✓ Compared with non-Hispanic Whites, all Asian subgroups except Japanese and US-born Chinese men had lower CRC incidence.
- ✓ Residence in an ethnic enclave was directly associated with decreased CRC incidence.
- ✓ The significant associations between CRC incidence and nativity and residence in an ethnic enclave on CRC incidence suggest a substantial effect of acquired environmental factors.
- ✓ In contrast with temporal trends among non-Hispanic Whites, CRC incidence did not decline significantly over time among most Asian subgroups during our study period.
- ✓ These contrasting trends may relate, in part, to disparities in screening rates in Asians compared with non-Hispanic Whites in the United States.

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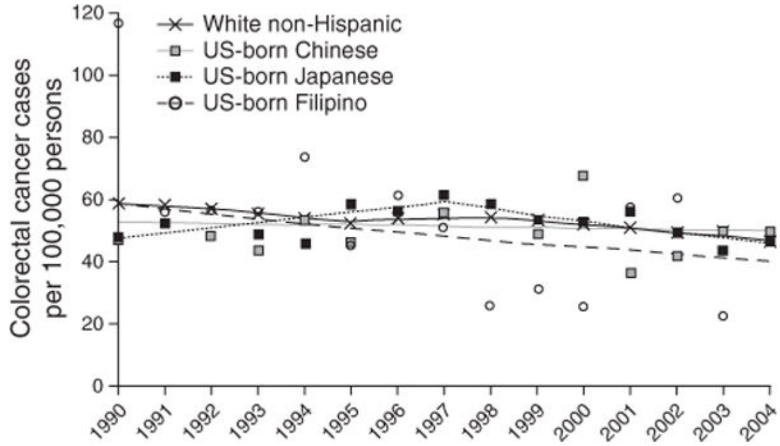

Figure 1.

Age-adjusted colorectal cancer (CRC) incidence trends for US- born Asian subgroups and non-Hispanic Whites in California. In the study period, overall CRC incidence was comparable in US-born Japanese and Chinese, and lower in US-born Filipino, than in non-Hispanic Whites.

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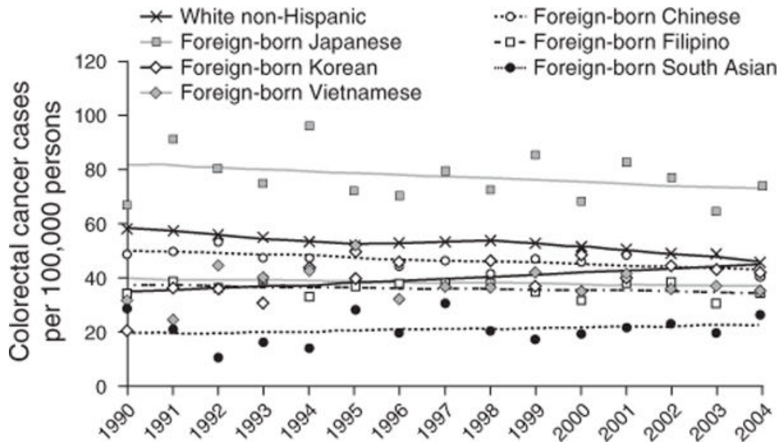

Figure 2.

Age-adjusted colorectal cancer (CRC) incidence trends for foreign-born Asian subgroups and non-Hispanic Whites in California. In the study period, overall CRC incidence was higher in foreign-born Japanese and lower in other foreign-born Asian subgroups than in non-Hispanic Whites.

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Table 1

Demographic and tumor characteristics among California patients diagnosed with invasive colorectal cancer, 1990 to 2004

	White non-Hispanic	Chinese		Japanese		Filipino		Korean	South Asian	Vietnamese
		US-born	Foreign-born	US-born	Foreign-born	US-born	Foreign-born	Foreign born	Foreign born	Foreign born
Total CRC cases, N	153,804	781	4,864	2,214	1,293	298	3,623	1,389	453	1,244
Sex										
Women, *n* (%)	75,546 (49.1%)	321 (41.1%)	2,336 (48.0%)	929 (42.0%)	870 (67.3%)	133 (44.6%)	1,662 (45.9%)	675 (48.6%)	176 (38.9%)	600 (48.2%)
Men, *n* (%)	78,258 (50.9%)	460 (58.9%)	2,528 (52.0%)	1,285 (58.0%)	423 (32.7%)	165 (55.4%)	1,961 (54.1%)	714 (51.4%)	277 (61.1%)	644 (51.8%)
Anatomic subsite										
Proximal colon, *n* (%)	64,951 (42.2%)	237 (30.3%)	1,597 (32.8%)	751 (33.9%)	397 (30.7%)	74 (24.8%)	902 (24.9%)	391 (28.1%)	144 (31.8%)	353 (28.4%)
Distal colon, *n* (%)	39,444 (25.6%)	277 (35.5%)	1,655 (34.0%)	658 (29.7%)	434 (33.6%)	90 (30.2%)	1,263 (34.9%)	378 (27.2%)	134 (29.6%)	411 (33.0%)
Rectum, *n* (%)	42,054 (27.3%)	240 (30.7%)	1,450 (29.8%)	735 (33.2%)	425 (32.9%)	126 (42.3%)	1,317 (36.4%)	572 (41.2%)	148 (32.7%)	443 (35.6%)
Other, *n* (%)	7,355 (4.8%)	27 (3.5%)	162 (3.3%)	70 (3.2%)	37 (2.9%)	8 (2.7%)	141 (3.9%)	48 (3.5%)	27 (6.0%)	37 (3.0%)
Age (years)										
< 50, *n* (%)	9,399 (6.1%)	122 (15.6%)	468 (9.6%)	129 (5.8%)	86 (6.7%)	83 (27.9%)	460 (12.7%)	197 (14.2%)	103 (22.7%)	245 (19.7%)
50–74, *n* (%)	74,944 (48.7%)	457 (58.5%)	2,501 (51.4%)	1,299 (58.7%)	814 (63.0%)	185 (62.1%)	2,085 (57.5%)	861 (62.0%)	257 (56.7%)	731 (58.8%)
75+, *n* (%)	69,461 (45.2%)	202 (25.9%)	1,895 (39.0%)	786 (35.5%)	393 (30.4%)	30 (10.1%)	1,078 (29.8%)	331 (23.8%)	93 (20.5%)	268 (21.5%)
Summary stage										
In situ[a], *n*	9,694	58	260	128	78	17	159	61	14	72
Localized, *n* (%)	57,367 (37.3%)	314 (40.2%)	1,602 (32.9%)	793 (35.8%)	407 (31.5%)	99 (33.2%)	1,094 (30.2%)	458 (33.0%)	144 (31.8%)	381 (30.6%)
Regional, *n* (%)	58,819 (38.2%)	262 (33.5%)	1,893 (38.9%)	829 (37.4%)	503 (38.9%)	114 (38.3%)	1,356 (37.4%)	538 (38.7%)	170 (37.5%)	491 (39.5%)
Distant, *n* (%)	28,010 (18.2%)	123 (15.7%)	820 (16.9%)	373 (16.8%)	218 (16.9%)	49 (16.4%)	694 (19.2%)	224 (16.1%)	72 (15.9%)	223 (17.9%)
NA and unstaged, *n* (%)	9,610 (6.2%)	82 (10.5%)	550 (11.3%)	220 (9.9%)	165 (12.8%)	36 (12.1%)	479 (13.2%)	169 (12.2%)	67 (14.8%)	149 (12.0%)
Neighborhood SES (*quintiles*)[b]										
1st (lowest), *n* (%)	14,379 (9.3%)	47 (6.0%)	734 (15.1%)	216 (9.8%)	145 (11.2%)	28 (9.4%)	489 (13.5%)	261 (18.8%)	34 (7.5%)	210 (16.9%)
2nd, *n* (%)	27,976 (18.2%)	87 (11.1%)	751 (15.4%)	370 (16.7%)	213 (16.5%)	38 (12.8%)	690 (19.0%)	262 (18.9%)	51 (11.3%)	331 (26.6%)
3rd, *n* (%)	34,849 (22.7%)	134 (17.2%)	793 (16.3%)	477 (21.5%)	248 (19.2%)	64 (21.5%)	976 (26.9%)	240 (17.3%)	75 (16.6%)	280 (22.5%)
4th, *n* (%)	37,310 (24.3%)	208 (26.6%)	1,127 (23.2%)	633 (28.6%)	349 (27.0%)	88 (29.5%)	855 (23.6%)	265 (19.1%)	108 (23.8%)	240 (19.3%)

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	White non-Hispanic	Chinese		Japanese		Filipino		Korean	South Asian	Vietnamese
		US-born	**Foreign-born**	**US-born**	**Foreign-born**	**US-born**	**Foreign-born**	**Foreign born**	**Foreign born**	**Foreign born**
5th (highest), *n* (%)	39,290 (25.5%)	305 (39.1%)	1,459 (30.0%)	518 (23.4%)	338 (26.1%)	80 (26.8%)	613 (16.9%)	361 (26.0%)	185 (40.8%)	183 (14.7%)

CRC, colorectal cancer; SES, socioeconomic status; NA, not applicable.

[a] *In situ* carcinomas are not included in the total for invasive colorectal cancer, and therefore do not include a %.

[b] Socioeconomic status is based on (census tract or block group) assignment using 1990 Census data for cases diagnosed for the period 1990–1995, and 2000 Census data for cases diagnosed for the period 1996 +.

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Table 2

Invasive colorectal cancer incidence rates for California White non-Hispanic and Asian subgroups, 1990–2004

	White non-Hispanic	Chinese		Japanese		Filipino		Korean	South Asian	Vietnamese
		US-born	Foreign-born	US-born	Foreign-born	US-born	Foreign-born	Foreign born	Foreign born	Foreign born
Women and men										
Person-years	248,644,451	4,441,362	9,745,194	3,235,348	1,799,976	4,219,099	9,177,355	3,858,657	3,253,808	4,714,592
CRC cases/100,000 (95% CI)	52.8 (52.5–53.0)	49.3 (45.8–52.9)	46.1 (44.7–47.4)	52.2 (50.0–54.5)	74.6 (70.1–79.2)	42.6 (37.2–48.4)	36.0 (34.8–37.3)	40.7 (38.5–43.2)	22.0 (19.7–24.5)	38.1 (35.7–40.5)
Incidence rate ratio vs. White non-Hispanic (95% CI)	NA	0.93 (0.87–1.00) P=0.05	0.87 (0.83–0.90) $P < 0.0001$	0.99 (0.95–1.03) P=0.30	1.41 (1.34–1.49) $P < 0.00001$	0.81 (0.72–0.90) $P < 0.001$	0.68 (0.66–0.70) $P < 0.0001$	0.77 (0.73–0.81) $P < 0.0001$	0.42 (0.38–0.46) $P < 0.0001$	0.72 (0.68–0.76) $P < 0.0001$
Incidence rate ratio vs. US-born Asian ethnic group (95% CI)	NA	NA	0.93 (0.87–1.01) P=0.05	NA	1.43 (1.33–1.53) $P < 0.00001$	NA	0.85 (0.75–0.95) $P < 0.01$	NA	NA	NA
Women										
Person-years	125,736,904	2,162,645	5,163,042	1,620,372	1,113,155	2,047,954	5,095,851	2,099,392	1,495,944	2,329,852
CRC cases/100,000 (95% CI)	45.1 (44.8–45.4)	37.0 (33.0–41.3)	40.7 (39.1–42.5)	42.8 (40.0–45.7)	63.6 (58.9–68.5)	36.8 (29.7–45.0)	28.5 (27.1–30.0)	33.9 (31.3–36.8)	17.7 (14.8–21.0)	35.3 (32.3–38.6)
Incidence rate ratio vs. White non-Hispanic (95% CI)	NA	0.82 (0.74–0.92) $P < 0.001$	0.90 (0.87–0.94) $P < 0.0001$	0.95 (0.89–1.01) P=0.056	1.41 (1.32–1.51) $P < 0.0001$	0.82 (0.69–0.97) $P < 0.01$	0.63 (0.60–0.66) $P < 0.0001$	0.75 (0.70–0.81) $P < 0.0001$	0.39 (0.34–0.46) $P < 0.0001$	0.78 (0.72–0.85) $P < 0.0001$
Incidence rate ratio vs. US-born Asian ethnic group (95% CI)	NA	NA	1.10 (0.98–1.24) P=0.054	NA	1.49 (1.36–1.63) $P < 0.0001$	NA	0.77 (0.65–0.92) $P < 0.01$	NA	NA	NA
Men										
Person-years	122,907,547	2,278,717	4,582,152	1,614,976	686,821	2,171,145	4,081,504	1,759,265	1,757,864	2,384,740
CRC cases/100,000 (95% CI)	62.7 (62.3–63.2)	65.3 (59.0–71.9)	52.3 (50.3–54.5)	62.3 (58.8–66.0)	121.9 (109.1–135.6)	50.3 (42.0–59.6)	45.9 (43.9–48.1)	51.0 (46.9–55.4)	26.4 (22.7–30.5)	40.9 (37.3–44.8)
Incidence rate ratio vs. White non-Hispanic (95% CI)	NA	1.04 (0.95–1.14) P=0.81	0.83 (0.80–0.87) $P < 0.0001$	0.99 (0.94–1.05) P=0.41	1.94 (1.77–2.14) $P < 0.0001$	0.80 (0.69–0.93) $P < 0.01$	0.73 (0.70–0.77) $P < 0.0001$	0.81 (0.76–0.88) $P < 0.0001$	0.42 (0.37–0.47) $P < 0.0001$	0.65 (0.60–0.70) $P < 0.0001$
Incidence rate ratio vs. US-born Asian ethnic group (95% CI)	NA	NA	0.80 (0.73–0.89) $P < 0.0001$	NA	1.96 (1.75–2.18) $P < 0.0001$	NA	0.91 (0.78–1.07) P=0.13	NA	NA	NA

CI, confidence interval; NA, not applicable

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Table 3

Invasive colorectal cancer incidence trends for California White non-Hispanic and Asian subgroups, 1990–2004

	White non-Hispanic	Chinese		Japanese		Filipino		Korean	South Asian	Vietnamese
		US-born	**Foreign-born**	**US-born**	**Foreign-born**	**US-born**	**Foreign-born**	**Foreign born**	**Foreign born**	**Foreign born**
Women and Men										
CRC cases/100,000										
1990	58.2	46.8	48.9	47.7	67.2	116.3	34.2	21.2	29	31.9
1997	54.4	55.3	46.6	61.2	79.5	50.5	38.4	36.9	31	37.4
2004	45.8	49.2	40.8	46.3	74.4	45.3	34.9	42.1	26.9	35.1
Trend 1, APC (95% CI)	−2.2 (−3.1 to −1.2) (1990–1995)	−0.4 (−2.7 to 1.9) (1990–2004)	−1.1 (−1.8 to −0.5) (1990–2004)	3.0 (−0.5 to 6.8) (1990–1997)	−0.8 (−2.2 to 0.6) (1990–2004)	−2.6 (−7.8 to 2.9) (1990–2004)	−0.5 (−1.6 to 0.5) (1990–2004)	1.8 (−0.1 to 3.8) (1990–2004)	1.0 (−2.1 to 4.3) (1990–2004)	−0.5 (−2.4 to 1.5) (1990–2004)
Trend 2, APC (95% CI)	1.1 (−3.0 to 5.4) (1995–1998)	—	—	−3.6 (−6.4 to −0.6) (1997–2004)	—	—	—	—	—	—
Trend 3, APC (95% CI)	−2.5 (−3.2 to −1.8) (1998–2004)	—	—	—	—	—	—	—	—	—
Women										
CRC cases/100,000										
1990	49.1	32.2	45.2	40.7	60.6	26.9	22.3	21.9	23.6	24.9
1997	46.6	38.3	38.1	44.4	71.8	80.8	26.2	29.6	16.4	30.4
2004	39.8	44.7	38	37.5	65.7	44.1	28	42.6	16.3	38
Trend 1, APC (95% CI)	−2.1 (−3.4 to −0.8) (1990–1995)	1.1 (−3.2 to 5.5) (1990–2004)	−0.8 (−1.8 to 0.1) (1990–2004)	−0.4 (−2.0 to 1.2) (1990–2004)	−0.2 (− 1.8 to 1.5) (1990–2004)	2.8 (−4.2 to 10.2) (1990–2004)	−0.3 (−2.0 to 1.5) (1990–2004)	1.9 (−0.3 to 4.1) (1990–2004)	2.5 (−1.6 to 6.8) (1990–2004)	0.2 (−2.5 to 3.0) (1990–2004)
Trend 2, APC (95% CI)	1.6 (−4.4 to 7.9) (1995–1998)	—	—	—	—	—	—	—	—	—
Trend 3, APC (95% CI)	−2.4 (−3.4 to −1.4) (1998–2004)	—	—	—	—	—	—	—	—	—
Men										
CRC cases/100,000										

	White non-Hispanic	Chinese		Japanese		Filipino		Korean	South Asian	Vietnamese
		US-born	Foreign-born	US-born	Foreign-born	US-born	Foreign-born	Foreign born	Foreign born	Foreign born
1990	71.5	62.5	53.2	55.4	94.4	1584.1	43.9	18.4	36.3	41
1997	64.4	75	56.8	78.8	121.2	16.4	52.6	47.4	46.2	46.1
2004	53	57.4	43.9	56.2	120	48.3	45	39.9	37.9	31.9
Trend 1, APC (95% CI)	−2.5 (−3.7 to −1.3) (1990–1995)	−1.2 (−4.0 to 1.7) (1990–2004)	−1.5 (−2.4 to −0.6) (1990–2004)	4.2 (0.2 to 8.5) (1990–1997)	−1.5 (−3.8to 0.8) (1990–2004)	−6.1 (−13.8 to 2.4) (1990–2004)	−0.1 (−1.2 : to 0.9) (1990–2004)	2.0 (−1.3 to 5.4) (1990–2004)	0.4 (−4.0 to 5.1) (1990–2004)	−1.3 (−4.1 to 1.5) (1990–2004)
Trend 2, APC (95% CI)	0.6 (−4.6 to 6.1) (1995–1998)	—	—	−4.5 (−7.6 to −1.3) (1997–2004)	—	—	—	—	—	—
Trend 3, APC (95% CI)	−2.7 (−3.6 to −1.8) (1998–2004)	—	—	—	—	—	—	—	—	—

APC, annual percentage change; CI, confidence interval; CRC, colorectal cancer.

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Table 4

Invasive colorectal cancer incidence rates by neighborhood socioeconomic status and ethnic enclave, 1998–2002

	White non-Hispanic			Asian/Pacific Islander non-Hispanic		
	Person-years	**CRC cases per 100,000 (95% CI)**	**Incidence rate ratio (95% CI)**	**Person-years**	**CRC cases per 100,000 (95% CI)**	**Incidence rate ratio (95% CI)**
Total	79,009,980	52.2 (51.8–52.7)		18,755,815	45.8 (44.7–46.9)	
Census tract level SES[a]						
1st (lowest)	5,755,215	69.3 (67.4–71.2)	Reference	2,147,590	48.6 (45.6–51.8)	Reference
2nd	13,199,685	55.6 (54.5–56.7)	0.80 (0.77–0.83) $P < 0.0001$	3,304,815	41.7 (39.4–44.2)	0.86 (0.79–0.94) $P < 0.001$
3rd	17,874,825	51.2 (50.2–52.1)	0.74 (0.71–0.76) $P < 0.0001$	3,654,795	49.6 (47.0–52.3)	1.02 (0.94–1.11) $P=0.66$
4th	20,222,430	50.7 (49.8–51.6)	0.73 (0.71–0.76) $P < 0.0001$	4,601,420	48.5 (46.2–50.9)	1.00 (0.92–1.08) $P=0.97$
5th (highest)	21,957,825	47.9 (47.1–48.8)	0.69 (0.67–0.71) $P < 0.0001$	5,047,195	41.4 (39.3–43.6)	0.85 (0.78–0.93) $P < 0.001$
Census tract level Asian ethnic enclave[a]						
1st (lowest)	—	—	—	465,105	53.8 (46.9–61.4)	Reference
2nd	—	—	—	1,300,525	51.0 (46.7–55.5)	0.95 (0.81–1.11) $P=0.52$
3rd	—	—	—	2,333,450	49.9 (46.6–53.4)	0.93 (0.80–1.08) $P=0.37$
4th	—	—	—	4,011,735	47.5 (45.1–50.0)	0.88 (0.77–1.02) $P=0.096$
5th (highest)	—	—	—	10,643,490	43.2 (41.8–44.6)	0.80 (0.70–0.92) $P < 0.01$
No quintile assigned						
Combined SES×enclave						
Low SES (1,2,3), most ethnic (4,5)	—	—	—	6,935,720	45.9 (44.2–47.7)	Reference
Low SES (1,2,3), least ethnic (1,2,3)	—	—	—	2,170,410	48.4 (45.2–51.8)	1.05 (0.97–1.14) $P=0.19$
High SES (4,5), most ethnic (4,5)	—	—	—	7,719,505	42.7 (40.9–44.4)	0.93 (0.88–0.98) $P < 0.05$
High SES (4,5), least ethnic (1,2,3)	—	—	—	1,928,670	53.2 (49.4–57.2)	1.16 (1.07–1.26) $P < 0.001$

No quintile assigned

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CI, confidence interval; SES, socioeconomic status.

[a]SES and Asian ethnic enclave based on 2000 Census data; developed via principal components analysis; SES is composite measure of Census variables capturing income, education, poverty, occupation, and so on; ethnic enclave is composite of variables capturing Asian population composition, language, recent immigration, and so on.