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Examining the Association Between Socioeconomic Status and Invasive Colorectal Cancer Incidence and Mortality in California

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Abstract

Background—Colorectal cancer (CRC) incidence and mortality rates vary across race/ethnicity. Socioeconomic status (SES) also influences CRC rates; however, these associations might be inconsistent across racial/ethnic groups and tumor subsite. We examined associations between area-level SES and CRC incidence and mortality in a population-based registry study of non-Hispanic Whites, African Americans, Hispanics, and Asians/Pacific Islanders from California.

Methods—Data on 52,608 incident CRC cases (1998–2002) and 14,515 CRC deaths (1999–2001) aged ≥50 years were obtained from the California Cancer Registry. Based on 2000 U.S. Census data, each cancer case and death was assigned a multidimensional census tract-level SES index. SES-specific quintiles of CRC incidence and mortality rates, incidence rate ratios (IRR) and mortality rate ratios, and 95% confidence intervals (CI) were estimated. Analyses were stratified by anatomical site, including left- versus right-sided tumors, race/ethnicity, and stage of disease.

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Results—Overall CRC incidence and SES did not show a clear association, yet patterns of associations varied across tumor subsite and race/ethnicity. Positive associations between SES and CRC incidence were found in Hispanics [SES Q5 v. Q1: IRR = 1.54, CI = 1.39–1.69], irrespective of the subsite. For Whites [SES Q5 v. Q1: IRR = 0.80, CI = 0.77–0.83], and African Americans [SES Q5 v. Q1: IRR = 0.83, CI = 0.70–0.97] inverse associations were observed, predominantly for left-sided tumors. Mortality rates declined with increasing SES in Whites, whereas in Hispanics mortality rates significantly increased with SES.

Conclusions—Our findings show that SES differences in CRC incidence and mortality vary considerably across anatomical subsite and race/ethnicity.

Impact—Studies combining area- and individual-level SES information are warranted.

Introduction

Colorectal cancer (CRC) is the third most common cancer in the United States (1, 2), accounting for approximately 10% of newly diagnosed cancers and 9% of cancer deaths (1). Incidence and mortality rates of CRC vary markedly across racial/ethnic groups. In the United States, African Americans and non-Hispanic Whites experience the highest incidence and mortality rates of CRC with Asians/Pacific Islanders and Hispanics having lower rates (2). Socioeconomic status (SES) has been inconsistently associated with incidence rates of CRC in the United States (3) with variable associations across racial/ethnic groups (4, 5). Lower SES has been consistently linked to higher mortality rates for CRC (3), yet less is known about how this relationship differs across racial/ethnic groups.

Over the past 2 decades, a shift in incidence toward more right-sided (ascending and transverse) than leftsided (descending and sigmoid) colon cancer has been reported (6–8). This has been attributed to differences in clinical and epidemiologic characteristics, molecular and genetic factors, and the use of colonoscopy and screening (7, 9–13). Furthermore, endoscopy screening for CRC has been positively associated with education, income, and health insurance coverage (14–16). Whether SES impacts the distribution of left- and right-sided colon cancer, particularly among racial/ethnic groups, is not well understood and has yet to be studied.

To further understand SES-related disparities in CRC, we examined the association between SES and incidence and mortality rates of CRC in a large, population-based study of CRC from the ethnically diverse state of California. In particular, we focused on examining the differences in these rates across racial/ethnic groups and tumor subsite.

Materials and Methods

Study population

Incident first primary cases of invasive CRC (n = 58,897) diagnosed from January 1998 through December 2002 and CRC deaths (n = 15,546) that occurred from January 1999 through December 2001 were identified by the California Cancer Registry (CCR), comprising 3 registries that are part of the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program (Greater Bay Area Cancer Registry, Los

Angeles Cancer Surveillance Program, Cancer Registry of Greater California). These 5-year pericensal incidence and 3-year mortality periods were based on the availability of the appropriate population estimates to be used as denominators for rate calculations at the census tract level, based on 2000 Census data. For incident cases of CRC, data on age at cancer diagnosis, sex, race/ethnicity, residential address at diagnosis, and tumor subsite, stage, and grade were collected from medical records. For CRC deaths, age, sex, race/ethnicity, and residential address at death were abstracted from death records; information on tumor subsite was not available. Race/ethnicity was classified as 5 mutually exclusive groups: (i) non-Hispanic African American, (ii) non-Hispanic Asian/Pacific Islander, (iii) Hispanic (of any race), (iv) non-Hispanic White, and (v) other/unknown. Tumor subsite was classified according to the International Classification of Diseases for Oncology, Second Edition with right colon cancer (cecum, appendix, ascending colon, hepatic flexure, transverse colon; C18.0–C18.4), left colon cancer (splenic flexure, descending colon, sigmoid; C18.5–18.7), rectal cancer (rectal sigmoid junction, rectum; C19.9 and C20.9), and other (C18.8–C18.9; overlapping lesions and not specified). Tumor stage was categorized as localized, regional/metastasized, or not abstracted/unknown. Because of low numbers of cases of “other” subsite ($n = 2{,}251$) and of unknown stage ($n = 5{,}958$), these cancers were omitted from site- and stage-specific analyses, respectively. For the present study, CRC patients aged less than 50 years at diagnosis and death (5,892 incident cases and 997 deaths) were excluded to focus on more sporadic forms of CRC. Those with other/unknown race/ethnicity (397 cases and 34 deaths) were also excluded, resulting in a study population of 52,608 incident CRC cases (1998-2002) and 14,515 CRC deaths (1999-2001).

SES and population data

Residential addresses of the cancer cases and deaths were geo-coded to the census tract level, an area covering about 4,000 residents, and linked to SES characteristics from the U.S. Census Bureau for these census tracts (17). Patients with unknown census tract of residence were randomly allocated to census tracts within their county of residence.

A previously developed composite score of SES was used, created by principal component analysis based on 7 SES indicators from census data: (i) education (18); (ii) median household income; (iii) percentage living 200% below poverty level; (iv) percentage of blue-collar workers; (v) percentage older than 15 years in workforce, without job; (vi) median rent; and (vii) median house value (19). Each census tract was assigned this composite score and categorized in quintiles based on the statewide distribution. Supplementary Table S1 (20) shows the distribution of the 7 census-based indicator variables of SES and the racial/ethnic distribution for each SES quintile. In the lowest SES quintile (Q1), the mean years of education was 11 years in comparison to 15 years in the highest quintile (Q5); the median household income was $28,335 versus $89,254 in Q1 v. Q5, respectively. Population data from age-, sex-, and race-specific population counts for census tracts, were obtained from the modified age, race, sex, and Hispanic origin files from the 2000 U.S. census and used as the denominator in rate calculation. Because population estimates for census tracts were not available for intercensal years, the 2000 population counts were multiplied by 5 to estimate the total population at risk for the 5-year period of incidence and by 3 to estimate the 3-year period of mortality.

Statistical analysis

CRC incidence and mortality rates were calculated per 100,000 individuals and age-adjusted to the 2000 U.S. standard population. SES quintile-specific incidence rate ratios (IRR) and mortality rate ratios (MRR) of CRC and 95% confidence intervals (CI) were estimated. Stratification analyses were conducted to examine consistency of effects across anatomical site, tumor subsite (left- vs. right-sided tumors for IRR only), race/ethnicity, and stage at diagnosis (IRR only). All analyses were conducted using SEER*Stat, version 6.3.4.

Results

SES and CRC incidence

Table 1 shows the characteristics of the 52,608 invasive incident CRC cases diagnosed from 1998 through 2002. The largest proportion of cases were located in the right colon (*n* = 20,560; 39.1%) in comparison to the left colon (*n* = 14,969; 28.5%) and rectum (*n* = 14,828; 28.2%). A total of 55% of the cases had regional/metastasized disease and 58% were moderately differentiated with similar proportions across tumor subsites. About 22% of CRC cases were in the highest SES quintile, whereas 13.7% of CRC cases were in the lowest SES quintile.

There was no clear association between incidence rates of CRC and SES quintiles (Table 2). Incidence rates for right-sided colon cancer were slightly elevated in the highest SES quintile in comparison to the lowest quintile ($IRR_{SES\ Q5\ v.\ Q1}$ = 1.09; 95% CI: 1.04–1.14). For left colon cancer, rates were reduced for the highest than the lowest quintile ($IRR_{SES\ Q5\ v.\ Q1}$ = 0.93; 95% CI: 0.88–0.98) and among rectal cancer cases, no clear association was observed.

Significantly reduced incidence rates for CRC were associated with higher SES for non-Hispanic Whites ($IRR_{SES\ Q5\ v.\ Q1}$ = 0.80; 95% CI: 0.77–0.83) and African Americans ($IRR_{SES\ Q5\ v.\ Q1}$ = 0.83; 95% CI: 0.70–0.97; Table 2). SES differentials were strongest among Hispanics, with incidence rates of CRC significantly elevated among those in higher levels of SES in comparison to those in low levels of SES ($IRR_{SES\ Q5\ v.\ Q1}$ = 1.54; 95% CI: 1.39-1.69). Among Asians/Pacific Islanders, there was no clear association between SES and overall CRC incidence rates.

When stratifying the race-/ethnicity-specific analyses by cancer subsite, the direction of association for nonHispanic Whites remained consistent (inverse association); however, the IRR was lower when comparing highest to lowest SES level for left-sided ($IRR_{SES\ Q5\ v.\ Q1}$ = 0.77; 95% CI: 0.72-0.83) than for right-sided tumors ($IRR_{SES\ Q5\ v.\ Q1}$ = 0.91; 95% CI: 0.85-0.97). For rectal cancer, there was also a strong inverse association ($IRR_{SES\ Q5\ v.\ Q1}$ = 0.71; 95% CI: 0.65-0.76). For African Americans, the inverse association between SES and CRC incidence was significant for left-sided colon cancer ($IRR_{SESQ5\ v.\ Q1}$ = 0.72; 95%CI: 0.52-0.97) but not for right-sided colon or rectal cancer. For Hispanics, the positive associations between SES and colon cancer were seen for all subsites, but the effect estimate was stronger for right-sided ($IRR_{SES\ Q5\ v.\ Q1}$ = 1.85; 95% CI: 1.58-2.16) than for left-sided cancers ($IRR_{SES\ Q5\ v.\ Q1}$ = 1.50; 95% CI: 1.25-1.79) or rectal cancers ($IRR_{SES\ Q5\ v.\ Q1}$ = 1.34; 95% CI: 1.12-1.59). For Asians/Pacific Islanders, a positive association was suggested between SES and the incidence rate of right-sided colon cancer, yet no significant association was seen in left-sided colon or rectal tumors.

When comparing incidence rates between left- and right-sided colon cancers within each level of SES (Table 2), incidence rates of right-sided colon cancer were generally higher than the left-sided incidence rates. This pattern was similar across all racial/ethnic groups with the exception of Asians/Pacific Islanders for which incidence rates were higher for left-sided colon tumors than for right-sided tumors. Notably, among non-Hispanic Whites a consistent pattern of an inverse association between SES and CRC incidence was seen across subsite, although for Hispanics a positive association was observed for left-sided, right-sided, and rectal tumors.

In stage-stratified analysis (Table 3), a significant positive association was observed between CRC incidence and SES for localized disease most consistently among Hispanics. For regional/metastasized disease, no overall association between CRC incidence and SES was observed. Inverse patterns of association were observed for non-Hispanic Whites and African Americans, whereas for Hispanics a positive association was found.

SES and CRC mortality

Characteristics of the 14,515 CRC patients who died between 1999 and 2001 are described in Table 4. Approximately 74.0% of the CRC patients were non-Hispanic Whites, 10.8% Hispanics, 8.0% African Americans, and 7.5% Asians/Pacific Islanders. A total of 14% of patients were in the lowest SES category and approximately 21% were in each of the other quintiles.

Mortality rates of CRC varied across race/ethnicity categories with highest rates among African Americans followed by non-Hispanic Whites, Hispanics, and Asians/Pacific Islanders (Table 5). In addition, mortality rates for colon cancer were consistently higher than that of rectal cancer, irrespective of ethnicity. Overall, reduced mortality rates of total CRC were associated with higher levels of SES ($MRR_{SES\ Q\ 5\ v.\ Q1}$ = 0.89;95% CI0.84–0.94; Table 5).This inverse pattern of association was seen for both deaths of colon and rectal cancers. Distinct patterns of associations were seen across the different racial/ethnic groups. For non-Hispanic Whites, mortality rates of CRC decreased significantly with higher levels of SES ($MRR_{SES\ Q5\ v.\ Q1}$ = 0.76; 95% CI 0.71-0.82). For African Americans, a similar nonsignificant inverse trend was observed. In contrast, a significant positive association between SES and CRC mortality was seen for Hispanics ($MRR_{SES\ Q5\ v.\ Q1}$ = 1.40; 95% 1.14-1.71). For Asians/Pacific Islanders, mortality rates for CRC were not significantly associated with SES. Similar patterns of ethnic-specific associations were observed for both colon and rectal cancers.

Discussion

In this large population-based study of CRC patients, there were no overall associations between SES and CRC incidence rates; but rates differed by race/ethnicity and anatomical site. In ethnic-specific analyses, a positive association between CRC incidence rates and SES level was seen only among Hispanics; whereas among non-Hispanic Whites and

African Americans inverse associations were observed and no associations were seen for Asians/Pacific Islanders. Mortality rates of overall CRC were lower among patients at higher levels of SES. Yet, this inverse association was restricted to non-Hispanic Whites, whereas a positive association was seen among Hispanics.

Previous studies conducted in the United States and Canada (3) support our findings of lower incidence rates of CRC observed among those at higher levels of SES among non-Hispanic Whites and African Americans. This may be attributed to common CRC risk factors, such as physical inactivity, obesity, or unhealthy diet choices (21), which have been reported to be more prevalent among low SES populations (22, 23). In addition, utilization and access to health care among non-Hispanic Whites and African Americans, in particular, participation in CRC screening programs, may play an important role. With increased opportunity for screening among those at higher levels of SES, early detection and removal of precancerous adenoma polyps may lead to lower disease rates among those of higher SES. Data from the California Health Interview Survey (2001) indicate that 55% of non-Hispanic Whites and 54% of African Americans over 50 years of age received a fecal occult blood test, sigmoidoscopy, or colonoscopy within the past 5 years with higher screening rates seen with increasing household income and education (24, 25). In comparison, lower screening rates for Hispanics and Asians/Pacific Islanders (36% and 43%, respectively) were observed (24, 25). Having health insurance has been associated with higher screening rates (26), and physicians have been found to be less likely to discuss screening with patients of lower education (27). Furthermore, barriers in CRC screening, such as fear of injury, are more frequently reported in low SES subjects than in those of high SES (26). Thus, greater acceptance and utilization of CRC screening among higher SES non-Hispanic Whites and African Americans may contribute to the inverse association between SES and CRC.

Conversely, among Hispanics higher incidence rates of CRC were associated with higher levels of SES. Higher SES Hispanics may be more acculturated and adopt a more “westernized lifestyle” of physical inactivity, obesity, increased red meat consumption, and other health behaviors that serve as CRC risk factors (21). Supporting this hypothesis are subanalyses of a neighborhood ethnic enclave index (composed of language and immigration-related census variables; 28-30), in which we found that Hispanics living in more acculturated neighborhoods had higher incidence rates of CRC than those living in lower acculturation neighborhoods (highest to lowest quintile incidence rate per 100,000: Q5 = 148.7; Q4 = 138.7; Q3 = 131.6; Q2 = 118.3; Q1 = 94.9; data not shown).

For Asians/Pacific Islanders, we did not find clear associations between SES and CRC incidence, which might in part be attributed to the heterogeneous composition of this racial/ethnic group. A recent study on CRC incidence trends based on data from the CCR indicated that despite decreasing trends in CRC incidence for Asians/Pacific Islanders overall, the incidence is actually increasing for some subgroups (31).

In the United States, CRC incidence trends in 1980s and 1990s have shown a decline in rates of left-sided colon cancer whereas right-sided cancer rates remained unchanged (7). Data from 2000 onward show a decline in right-sided tumors although less steep than for left-sided tumors (32). Besides a differing role of genetic and environmental risk factors in left-versus right-sided tumor development, screening procedures might account for the difference in site-specific trends (7, 32) because left-sided colon cancer has been seen to be more likely screen detected than right-sided tumors (33). With higher SES reported to be associated with higher screening rates (14-16), we investigated whether the distribution of tumor subsite varied across SES levels. For left-sided colon cancer, SES was inversely associated with incidence of disease, where-as for right-sided colon cancer a positive association was observed. In ethnic-specific analyses, the inverse association between SES and colon cancer was more pronounced for left-sided than for right-sided tumors among Non-Hispanic Whites and African Americans, pointing to a stronger role of SES in left-sided tumors.

The reduced mortality rates of CRC associated with higher levels of SES is likely attributable to better health care access, informed education on health promoting behaviors, and avoidance of high-risk behaviors (34). Furthermore, greater screening participation seen in higher SES groups (14) allow for the removal of polyps and the detection of early stage disease (35). Racial/ethnic differences in the association between SES and CRC mortality were evident with a significant inverse association seen in non-Hispanic Whites although a significant positive association was observed among Hispanics.

Prior studies have similarly found that U.S. Hispanics have lower mortality rates than non-Hispanic Whites, despite lower income and less education (36-38). Possible explanations for this “Hispanic paradox” (38) has been attributed to healthier Latinos migrating to the United States, the return of Hispanics to their native country to die in one’s birthplace, and/or better social support resulting in improved health outcomes. Studies of cancer survival in Californian Hispanics indicate that a higher percentage of foreign-born Hispanics leave the country for medical care than U.S.-born Hispanics (29, 39). However, this migration effect may be too small to completely account for the Hispanic paradox (40). Additional studies of cancer survival in Hispanics with active follow-up and well-characterized information on place of birth are needed to clarify these observations.

Strengths of our study include the large multiethnic population, representing the diversity of the state of California and the use of census tracts as smallest geographic units, which are more homogeneous with regard to SES than larger geographic units such as counties. The use of area-based measures of SES allow for capturing elements of the socioeconomic environment that might not be attainable by individual-level data (41). Our comprehensive measure of SES included several domains of SES (e.g., education, income, employment) in contrast to using a single SES domain. We recognize that various SES measures may conduct differently across racial/ethnic groups such that within the same level of SES, individuals from different ethnic groups may not share the same level of power, prestige, and opportunities (19).

There are limitations to our study. For some subanalyses, the number of cases for some rates was small, especially among African Americans, leading to unstable associations. Furthermore, our grouping of different Asian populations and Pacific Islanders into one racial/ethnic category may not accurately reflect the associations seen in specific subpopulations. The cross-sectional design of this study and use of area-level neighborhood

SES data in the absence of individual-level data limits the consideration of health behaviors and confounders that may further clarify the observed associations. In addition, ecologic fallacy may occur when area-level measures of SES do not accurately reflect individual levels of SES. Finally, we used the 2000 U.S. population counts to calculate population denominators for intercensal years, which may not represent the true population size of the incidence and mortality periods of analysis.

In conclusion, this study shows that the impact of SES on CRC incidence and mortality rates differs across racial/ethnic groups. These associations inform future studies having detailed individual-level data on health behaviors, screening, biologic markers as well as area-level measures of the contextual features of the neighborhood environment to comprehensively disentangle these complex interrelationships.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics of incident CRC cases, California 1998-2002

	Total CRC (*n* = 52,608) *n* (%)	**Right-sided colon cancer (*n* = 20,560) *n* (%)**	**Left-sided colon cancer (*n* = 14,969) *n* (%)**	**Rectal cance (*n* = 14,828) *N* (%)**
Age group				
50–59 years	9,141 (17.4)	2,528 (12.3)	2,908 (19.4)	3,467 (23.4)
60–69 years	12,944 (24.6)	4,464 (21.7)	3,989 (26.6)	4,116 (27.8)
70–79 years	17,024 (32.4)	7,089 (34.5)	4,853 (32.4)	4,468 (30.1)
80+ years	13,499 (25.7)	6,479 (31.5)	3,219 (21.5)	2,777 (18.7)
Male	26,681 (50.7)	9,179 (44.6)	8,067 (53.9)	8,399 (56.6)
Female	25,927 (49.3)	11,381 (55.4)	6,902 (46.1)	6,429 (43.4)
Race/ethnicity				
Non-Hispanic White	37,407 (71.1)	15,247 (74.2)	10,204 (68.2)	10,293 (69.4)
African American	3,475 (6.6)	1,505 (7.3)	1,039 (6.9)	756 (5.1)
Hispanic	6,427 (12.2)	2,257 (11.0)	1,856 (12.4)	2,050 (13.8)
Asian/Pacific Islander	5,299 (10.1)	1,551 (7.5)	1,870 (12.5)	1,729 (11.7)
Tumor stage				
Localized	17,482 (33.2)	5,983 (29.1)	5,561 (37.2)	5,835 (39.4)
Regional/metastasized	29,147 (55.4)	12,777 (62.1)	8,167 (54.6)	7,264 (49.0)
Unknown	5,958 (11.3)	1,800 (8.8)	1,241 (8.3)	1,729 (11.7)
Tumor grade				
Well differentiated	4,691 (8.9)	1,691 (8.2)	1,653 (11.0)	1,290 (8.7)
Moderately differentiated	30,853 (58.6)	11,983 (58.3)	9,540 (63.7)	9,007 (60.7)
Poorly differentiated	8,846 (16.8)	4,709 (22.9)	1,929 (12.9)	2,037 (13.7)
Unknown	8,218 (15.6)	2,177 (10.6)	1,847 (12.3)	2,494 (16.8)
SES quintile				
Q1 (lowest)	7,226 (13.7)	2,632 (12.8)	2,170 (14.5)	2,092 (14.1)
Q2	10,624 (20.2)	3,997 (19.4)	3,032 (20.3)	3,065 (20.7)
Q3	11,414 (21.7)	4,423 (21.5)	3,187 (21.3)	3,298 (22.2)
Q4	11,814 (22.5)	4,803 (23.4)	3,236 (21.6)	3,299 (22.2)
Q5 (highest)	11,530 (21.9)	4,705 (22.9)	3,344 (22.3)	3,074 (20.7)

Table 2

Overall CRC and subsite incidence rates by SES quintile and race/ethnicity, California 1998–2002[a]

		Total CRC				Right colon cancer				Left colon cancer				Rectum cancer			
		n	Rate	IRR	(95% CI)	*n*	Rate	IRR	(95% CI)	*n*	Rate	IRR	(95% CI)	*n*	Rate	IRR	(95% CI)
All	Q1	7,226	134.0	1.00		2,632	49.3	1.00		2,170	40.0	1.00		2,092	38.3	1.00	
	Q2	10,624	140.7	**1.05**	**(1.02–1.08)**	3,997	53.0	**1.08**	**(1.02-1.13)**	3,032	40.1	1.00	(0.95-1.06)	3,065	40.5	**1.06**	**(1.00-1.12)**
	Q3	11,414	133.9	0.99	(0.97-1.03)	4,423	51.8	**1.05**	**(1.00-1.10)**	3,187	**37.4**	**0.93**	**(0.88-0.99)**	3,298	38.8	1.01	(0.96-1.07)
	Q4	11,814	135.3	1.01	(0.98-1.04)	4,803	55.1	**1.12**	**(1.06-1.17)**	3,236	**37.1**	**0.93**	**(0.88-0.98)**	3,299	37.7	0.99	(0.93-1.04)
	Q5	11,530	129.5	**0.97**	**(0.94-1.00)**	4,705	53.7	**1.09**	**(1.04-1.14)**	3,344	**37.3**	**0.93**	**(0.88-0.98)**	3,074	33.8	**0.88**	**(0.83-0.93)**
Non-Hispanic	Q1	3,380	160.2	1.00		1,289	59.6	1.00		967	46.4	1.00		953	46.4	1.00	
White	Q2	7,019	147.6	**0.92**	**(0.88-0.96)**	2,747	56.7	0.95	(0.89-1.02)	1,936	41.2	**0.89**	**(0.82-0.96)**	1,972	42.3	**0.91**	**(0.84-0.99)**
	Q3	8,455	134.5	**0.84**	**(0.81-0.87)**	3,387	52.8	**0.89**	**(0.83-0.95)**	2,282	36.6	**0.79**	**(0.73-0.85)**	2,393	39.1	**0.84**	**(0.78-0.91)**
	Q4	9,150	135.0	**0.84**	**(0.81-0.88)**	3,865	56.3	0.94	(0.89-1.01)	2,370	35.4	**0.76**	**(0.71-0.82)**	2,532	37.9	**0.82**	**(0.76-0.88)**
	Q5	9,403	127.8	**0.80**	**(0.77-0.83)**	3,959	54.2	**0.91**	**(0.85-0.97)**	2,649	35.9	**0.77**	**(0.72-0.83)**	2,443	32.8	**0.71**	**(0.65-0.76)**
African	Q1	1209	172.9	1.00		506	72.6	1.00		380	54.1	1.00		260	36.8	1.00	
American	Q2	912	161.7	0.94	(0.86-1.02)	375	68.0	0.94	(0.82-1.07)	281	48.7	0.90	(0.77-1.05)	205	35.4	0.96	(0.80-1.16)
	Q3	681	168.4	0.97	(0.88-1.07)	300	76.5	1.05	(0.91-1.22)	195	47.3	0.87	(0.73-1.05)	154	36.1	0.98	(0.79-1.21)
	Q4	474	153.1	**0.89**	**(0.79-0.99)**	231	76.7	1.06	(0.90-1.24)	126	38.8	**0.72**	**(0.58-0.89)**	96	29.6	0.80	(0.62-1.03)
	Q5	199	143.5	**0.83**	**(0.70-0.97)**	93	68.0	0.94	(0.73-1.18)	57	38.9	**0.72**	**(0.52-0.97)**	41	29.3	0.79	(0.55-1.13)
Hispanic	Q1	1,948	96.5	1.00		640	33.4	1.00		567	27.3	1.00		660	31.0	1.00	
	Q2	1,670	115.6	**1.20**	**(1.12-1.28)**	582	42.9	**1.28**	**(1.14-1.45)**	463	31.1	1.14	(1.00-1.30)	540	35.2	**1.14**	**(1.01-1.28)**
	Q3	1,283	122.1	**1.27**	**(1.18-1.36)**	452	44.8	**1.34**	**(1.18-1.53)**	381	35.4	**1.29**	**(1.13-1.49)**	401	36.5	**1.18**	**(1.03-1.34)**
	Q4	906	134.2	**1.39**	**(1.28-1.51)**	338	53.5	**1.60**	**(1.39-1.84)**	269	38.2	**1.40**	**(1.20-1.63)**	264	37.0	**1.19**	**(1.02-1.39)**
	Q5	620	148.1	**1.54**	**(1.39-1.69)**	245	61.6	**1.85**	**(1.58-2.16)**	176	40.9	**1.50**	**(1.25-1.79)**	185	41.6	**1.34**	**(1.12-1.59)**
Asian/Pacific	Q1	689	126.9	1.00		249	36.4	1.00		256	47.2	1.00		219	40.1	1.00	
Islander	Q2	1,023	132.2	1.04	(0.94-1.15)	261	38.5	1.06	(0.89-1.28)	352	45.4	0.96	(0.89-1.24)	348	44.5	1.11	(0.93-1.32)
	Q3	995	125.2	0.99	(0.89-1.09)	273	37.4	1.03	(0.85-1.24)	329	40.9	0.87	(0.84-1.18)	350	42.4	1.06	(0.89-1.26)
	Q4	1,284	135.7	1.07	(0.97-1.18)	348	40.7	1.12	(0.94-1.34)	471	49.1	1.04	(0.89-1.22)	407	41.5	1.03	(0.87-1.23)
	Q5	1,308	132.4	1.04	(0.95-1.15)	420	43.8	**1.20**	**(1.01-1.44)**	462	46.0	0.98	(0.83-1.15)	405	38.6	0.96	(0.81 -1.14)

n, number of cases; IRR, incidence rate ratio; CI, confidence interval.

[a]SES quintile (Q1, lower SES; Q5, higher SES); rates are per 100,000 and age-adjusted to the 2000 U.S. standard population (bold numbers indicate significant associations $P < 0.05$).

Table 3

CRC incidence rates for localized and regional/metastasized tumors by SES quintile and race/ ethnicity, California 1998–2002[a]

		Localized				Regional/metastasized			
		$n^{\dagger}$	Rate	IRR	(95% CI)	$n^{\dagger}$	Rate	IRR	(95% CI)
All	Q1	2,217	41.0	1.00		4,028	74.4	1.00	
	Q2	3,240	42.8	1.04	(0.99-1.10)	5,829	77.2	1.04	(1.00-1.08)
	Q3	3,676	43.1	1.05	(1.00-1.11)	6,170	72.5	0.97	(0.94-1.01)
	Q4	4,050	46.4	**1.13**	**(1.07-1.19)**	6,638	76.1	1.02	(0.98-1.06)
	Q5	4,299	48.1	**1.17**	**(1.11-1.23)**	6,482	72.7	0.98	(0.94-1.02)
Non-Hispanic White	Q1	1,002	47.5	1.00		1,788	85.4	1.00	
	Q2	2,123	44.9	0.94	(0.87-1.02)	3,709	78.4	**0.92**	**(0.87-0.97)**
	Q3	2,705	43.2	**0.91**	**(0.85-0.98)**	4,461	71.2	**0.83**	**(0.79-0.88)**
	Q4	3,141	46.5	0.98	(0.91-1.05)	5,097	75.5	**0.88**	**(0.84-0.93)**
	Q5	3,514	47.7	1.00	(0.93-1.08)	5,245	71.2	**0.83**	**(0.79-0.88)**
African American	Q1	359	50.8	1.00		707	101.1	1.00	
	Q2	275	47.6	0.94	(0.80-1.10)	547	97.0	0.96	(0.86-1.08)
	Q3	216	53.2	1.05	(0.88-1.25)	400	97.6	0.96	(0.85-1.10)
	Q4	151	46.3	0.91	(0.74-1.11)	280	90.5	0.90	(0.77-1.03)
	Q5	66	45.5	0.90	(0.67-1.18)	118	84.5	0.84	(0.67-1.03)
Hispanic	Q1	628	30.8	1.00		1,139	55.4	1.00	
	Q2	533	36.7	**1.19**	**(1.06-1.35)**	950	64.3	**1.16**	**(1.06-1.27)**
	Q3	417	38.9	**1.26**	**(1.11-1.44)**	733	69.2	**1.25**	**(1.13-1.38)**
	Q4	301	44.4	**1.44**	**(1.25-1.67)**	519	75.7	**1.37**	**(1.22-1.53)**
	Q5	234	54.7	**1.78**	**(1.51-2.08)**	356	84.9	**1.53**	**(1.35-1.74)**
Asian/Pacific Islander	Q1	228	42.1	1.00		394	72.4	1.00	
	Q2	309	39.5	0.94	(0.79-1.12)	623	80.5	1.11	(0.98-1.27)
	Q3	338	41.9	1.00	(0.84-1.19)	576	71.6	0.99	(0.87-1.13)
	Q4	457	47.3	1.12	(0.95-1.33)	742	78.1	1.08	(0.95-1.22)
	Q5	485	47.8	1.14	(0.97-1.34)	763	77.2	1.07	(0.94-1.21)

n, number of cases; IRR, incidence rate ratio; CI, confidence interval.

[a]SES quintile (Q1, lower SES; Q5, higher SES); rates are per 100,000 and age-adjusted to the 2000 U.S. standard population (bold numbers indicate significant associations $P < 0.05$).

Table 4

Characteristics of CRC deaths, California 1999-2001

	Total CRC (*n* = 14,515) *n* (%)	Colon (*n* = 12,317) *n* (%)	Rectum (*n* = 2,198) *n* (%)
Age group			
50-59 years	1,678 (11.6)	1,353 (11.0)	325 (14.8)
60-69 years	2,764 (19.0)	2,293 (18.6)	471 (21.4)
70-79 years	4,681 (32.2)	3,961 (32.2)	720 (32.8)
80+ years	5,392 (37.1)	4,710 (38.2)	682 (31.0)
Male	7,215 (49.7)	6,002 (48.7)	1,213 (55.2)
Female	7,300 (50.3)	6,315 (51.3)	985 (44.8)
Ethnicity			
Non-Hispanic White	10,696 (73.7)	9,083 (73.7)	1,613 (73.4)
African American	1,166 (8.0)	1,024 (8.3)	142 (6.5)
Hispanic	1,564 (10.8)	1,312 (10.7)	252 (11.5)
Asian/Pacific Islander	1,089 (7.5)	898 (7.3)	191 (8.7)
SES			
Q1 (lower)	2,036 (14.0)	1,709 (13.9)	327 (14.9)
Q2	3,018 (20.8)	2,563 (20.8)	455 (20.7)
Q3	3,179 (21.9)	2,699 (21.9)	480 (21.8)
Q4	3,303 (22.8)	2,807 (22.8)	496 (22.6)
Q5 (higher)	2,979 (20.5)	2,539 (20.6)	440 (20.0)

Table 5

Overall CRC and subsite mortality rates by SES quintiles and ethnicity, California 1999-2001[a]

		Total CRC				Colon				Rectum and rectosigmoid junction			
		n	**Rate**	**MRR**	**(95% CI)**	***n***	**Rate**	**MRR**	**(95% CI)**	***n***	**Rate**	**MRR**	**(95% CI)**
All	Q1	2,036	64.5	1.00		1,709	54.3	1.00		327	10.2	1.00	
	Q2	3,018	66.8	1.03	(0.98-1.09)	2,563	56.7	1.04	(0.98-1.11)	455	10.1	0.98	(0.85-1.14)
	Q3	3,179	62.3	0.97	(0.91-1.02)	2,699	52.9	0.97	(0.92-1.03)	480	9.4	0.92	(0.80-1.07)
	Q4	3,303	62.6	0.97	(0.92-1.03)	2,807	53.2	0.98	(0.92-1.04)	496	9.4	0.92	(0.80-1.06)
	Q5	2,979	57.4	**0.89**	**(0.84-0.94)**	2,539	49.0	**0.90**	**(0.85-0.96)**	440	8.4	**0.82**	**(0.71-0.95)**
Non-Hispanic White	Q1	985	76.8	1.00		819	63.5	1.00		166	13.3	1.00	
	Q2	2,079	70.7	**0.92**	**(0.85-0.99)**	1,755	59.4	0.94	(0.86-1.02)	324	11.2	0.84	(0.69-1.02)
	Q3	2,433	63.2	**0.82**	**(0.76-0.89)**	2,061	53.3	**0.84**	**(0.77-0.91)**	372	9.8	**0.74**	**(0.61-0.89)**
	Q4	2,655	62.8	**0.82**	**(0.76-0.88)**	2,270	53.7	**0.85**	**(0.78-0.92)**	385	9.2	**0.69**	**(0.57-0.83)**
	Q5	2,544	58.5	**0.76**	**(0.71-0.82)**	2,178	50.1	**0.79**	**(0.73-0.86)**	366	8.3	**0.63**	**(0.52-0.76)**
African American	Q1	420	100.4	1.00		370	88.5	1.00		50	11.8	1.00	
	Q2	317	98.1	0.98	(0.84-1.13)	274	84.7	0.96	(0.81-1.12)	43	13.4	1.13	(0.73-1.74)
	Q3	213	91.7	0.91	(0.77-1.08)	194	82.9	0.94	(0.78-1.12)	19	8.8	0.74	(0.41-1.29)
	Q4	153	89.8	0.90	(0.73-1.08)	128	74.9	0.85	(0.68-1.04)	25	14.9	1.26	(0.74-2.10)
	Q5	63	80.2	0.80	(0.59-1.06)	58	74.7	0.84	(0.62-1.13)	^	^	^	^
Hispanic	Q1	490	43.5	1.00		400	36.2	1.00		90	7.3	1.00	
	Q2	406	50.9	**1.17**	**(1.02-1.34)**	356	44.4	**1.23**	**(1.05-1.43)**	50	6.5	0.89	(0.60-1.29)
	Q3	310	54.3	**1.25**	**(1.07-1.45)**	257	45.6	**1.26**	**(1.06-1.49)**	53	8.7	1.19	(0.82-1.71)
	Q4	224	58.1	**1.33**	**(1.13-1.58)**	189	49.5	**1.37**	**(1.13-1.64)**	35	8.6	1.18	(0.76-1.78)
	Q5	134	60.9	**1.40**	**(1.14-1.71)**	110	50.6	**1.40**	**(1.11-1.74)**	24	10.3	1.42	(0.85-2.27)
Asian/Pacific Islander	Q1	141	44.5	1.00		120	37.8	1.00		21	6.7	1.00	
	Q2	216	47.4	1.06	(0.85-1.33)	178	39.4	1.04	(0.82-1.33)	38	7.9	1.18	(0.68-2.13)
	Q3	223	49.6	1.11	(0.90-1.39)	187	42.0	1.11	(0.87-1.41)	36	7.7	1.14	(0.64-2.07)
	Q4	271	53.2	1.20	(0.97-1.48)	220	43.4	1.15	(0.91-1.45)	51	9.8	1.46	(0.86-2.58)
	Q5	238	43.7	0.98	(0.79-1.22)	193	35.5	0.94	(0.74-1.20)	45	8.1	1.21	(0.70-2.16)

n, number of cases; MRR, mortality rate ratio; CI, confidence interval.

[a]SES quintile (Q1, lower SES; Q5, higher SES); rates are per 100,000 and age-adjusted to the 2000 U.S. standard population (bold numbers indicate significant associations $P < 0.05$).

^ Statistic not displayed because of fewer than 15 cases.