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Colorectal Cancer Mortality Among Hispanics in California: Differences by Neighborhood Socioeconomic Status and Nativity

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Abstract

BACKGROUND—Socioeconomic status (SES) plays an important role in colorectal cancer (CRC) mortality, although the independent and joint effects with nativity and neighborhood factors have yet to be evaluated.

METHODS—With nearly one-third of all US Hispanics residing in California, the authors obtained information from the California Cancer Registry to examine the associations between neighborhood SES and mortality in all 33,146 Hispanic individuals diagnosed with CRC from 1988 through 2010, with a particular focus on associations among US-born and foreign-born Hispanics. Cox proportional hazards models were used to calculate hazard ratios (HRs) and 95% confidence intervals (95% CI) for overall and CRC-specific mortality.

RESULTS—Hispanics residing in lower SES neighborhoods demonstrated a higher rate of overall and CRC-specific mortality than those residing in high SES neighborhoods (SES quintile 1[low] vs quintile 5 [high]: HR, 1.15 [95% CI, 1.05–1.26] and HR, 1.16 [95% CI, 1.03–1.30], respectively). Nativity modified the associations between SES and mortality (P for interaction, .02 for overall and P for interaction, .01 for CRC-specific mortality) such that the SES associations were observed only among US-born (P for trend < .01 for overall and CRC-specific mortality) but not among foreign-born Hispanics.

CONCLUSIONS—Neighborhood SES demonstrates significant differential effects on overall and CRC-specific mortality between US-born and foreign-born Hispanics. Future efforts should

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CONFLICT OF INTEREST DISCLOSURES

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investigate the underlying contextual and individual-level factors that could account for these differential associations by nativity.

Keywords

colorectal cancer; mortality; Hispanics; socioeconomic status; nativity

INTRODUCTION

By the end of 2013, Hispanics were expected to represent the largest ethnic group in California, which has important implications for their health care needs and services. Currently, cancer is the leading cause of death among Hispanics in the United States. Colorectal cancer (CRC) was estimated in 2012 as the second and third leading cause of cancer deaths among US Hispanic men and women, respectively, after lung cancer for men and breast and lung cancer for women.[1] Mortality after CRC may be attributed to the complex interplay between clinical, social, economic, behavioral, and biological factors. Socioeconomic status (SES) is a key factor affecting mortality because it influences underlying prognostic factors, access to health insurance, early detection, and treatment.[1] This is important for Hispanics, who experience a lower median income and a higher poverty rate than the overall US population.[2] Furthermore, substantial SES differences are noted among Hispanics according to nativity. For example, foreign-born Hispanics have lower median household income and lower educational attainment than US-born Hispanics.[2] In addition, foreign-born Hispanics tend to live in Hispanic enclaves (neighborhoods with high percentages of Hispanics or Hispanic immigrants), which are generally neighborhoods of lower SES.[3,4]

Previous studies have for the most part observed an inverse association between SES and CRC mortality, with lower mortality rates observed among those of higher SES.[5–11] This inverse association has been shown to persist with adjustment of stage of disease,[12,13] an important clinical predictor of prognosis. To our knowledge, few studies to date have specifically included Hispanics[7,10,11] and inconsistent associations have been reported. In a recent study of the California Cancer Registry (CCR), lower CRC mortality rates were observed with higher neighborhood SES among Hispanics, in contrast to higher mortality rates with higher SES noted for non-Hispanic whites and African Americans.[7] This relationship between SES and CRC mortality remains to be clearly understood and differences by nativity, an important factor for health outcomes among Hispanics, has to our knowledge yet to be examined.

For the current study, we used the unique resource of the CCR enhanced with data regarding patient-level nativity and residential neighborhood factors including SES and degree of ethnic enclave status. Specifically, we conducted a large prospective analysis of 33,146 Hispanics with CRC to examine the association between SES and mortality after a CRC diagnosis, with a particular focus on US-born and foreign-born Hispanics.

MATERIALS AND METHODS

Study Population

We obtained CCR data on all patients diagnosed with primary invasive CRC (*International Classification of Disease for Oncology-3rd Edition* site codes C180–209, excluding histology codes 9050–9055, 9140, and 9590–9992) between January 1, 1988 and December 31, 2010. For each patient, we obtained CCR information regarding age, sex, race/ethnicity, marital status, census block group of residence at the time of diagnosis, stage at diagnosis (summarized as localized, regional, metastasized, or unknown), treatment modalities within the first 12 months after diagnosis, vital status as of December 31, 2010, and underlying cause of death. The North American Association of Central Cancer Registries Hispanic Identification Algorithm,[14] which is based on surname, maiden names, and/or birthplace, was used to improve the classification of Hispanic ethnicity.[15,16] All Hispanics with invasive CRC regardless of race were included. Classification of nativity (US-born or foreign-born) was described in detail previously.[17,18] Briefly, data regarding nativity were available in the CCR for 77% of the eligible cases for this study (62% from hospital records and 15% from death certificates). We estimated nativity for 21% of patients with unknown birthplace using a statistical imputation method that has been shown to have minimal bias.[19] Based on each patient's social security number (SSN), which indicates the state and year of issuance,[20,21] we classified patients who received their SSN before age 20 years as US-born and those who received their SSN at or after age 20 years as foreign-born. The cutpoint of 20 years was determined by comparison with self-reported nativity from interviews with 1127 Hispanic patients with cancer and maximization of the area under the resultant receiver operating characteristic curve.[22,23] The selected cutpoint resulted in immigrant status classifications associated with 81% sensitivity and 80% specificity for detecting foreign-born status in Hispanics. The remaining 2% of patients were assigned by age nativity distribution of the overall sample (2%).[20,21]

We determined neighborhood SES by patients' residential census block group using an index derived from principal components of 7 indicator variables of SES (education level; percentage unemployed and with a blue collar job; percentage at < 200% of the poverty line; and median household income, rent, and home value) using 2000 US Census data.[24] We also classified patients according to neighborhood Hispanic enclave status, which was based on the 2000 US Census block-group level variables (percentage linguistically isolated, percentage linguistically isolated who speak Spanish, percentage speaking limited English, percentage speaking limited English who spoke Spanish, percentage of recent immigrants, percentage Hispanic, and percentage foreign-born) and derived using principal components analysis. Methodological details were described previously.[17,18] Each patient with CRC was assigned into an SES or a Hispanic enclave quintile based on the distribution of neighborhood SES or Hispanic enclave, respectively, across all census block groups in California. After excluding 231 patients diagnosed at autopsy or by death certificate, the current study included 33,146 Hispanic individuals with invasive CRC. This project was approved by the Institutional Review Board of the Cancer Prevention Institute of California.

Statistical Analysis

We used Cox proportional hazards regression to estimate hazard ratios (HRs) and associated 95% confidence intervals (95% CI) to estimate associations with overall and CRC-specific mortality. For deceased patients, survival time was measured in days from the date of diagnosis to the date of death from any cause for all-cause mortality analyses or to the date of death from CRC for CRC-specific mortality analyses. Patients who died of other causes were censored at the time of death for analyses of CRC-specific death. Patients alive at the study end date (December 31, 2010) were censored at this time or at the date of last follow-up (ie, last known contact). Approximately 93% of censored patients had a follow-up date within 1 year of the study end date.

We tested the proportional hazards assumption by statistically testing the correlation between weighted Schoenfeld residuals and logarithmically transformed survival time. No violations of the assumption were observed. Multivariate Cox regression models included variables significant at $P < .05$ in unadjusted models (year of diagnosis, nativity, age at diagnosis, sex, marital status, neighborhood SES, Hispanic enclave, tumor size, tumor grade, and first course of treatment). Given that proportional hazards varied by stage at diagnosis (localized, regional, metastasized, and unknown), it was included as a stratifying variable in all Cox regression models, allowing the baseline hazard to vary across stage. All models were adjusted for clustering effect by block group. To examine whether the association for Hispanic enclave was independent from SES, Hispanic enclave was included in regression models with SES. Effect modification of the associations between neighborhood SES and mortality risk by nativity and stage at diagnosis were assessed by including an interaction term in the multivariable models and were considered present if the interaction terms were significant at $P < .05$. Stratification analyses were also conducted to examine the patterns of associations by nativity and stage at diagnosis. All statistical tests were performed using SAS statistical software (version 9.3; SAS Institute Inc, Cary, NC). All P values reported were 2-sided, and those that were < .05 were considered to be statistically significant.

RESULTS

In this California cohort of 33,146 Hispanic patients with CRC, the mean age of the patients at the time of diagnosis was 63.6 (standard deviation [SD], 14.6) years (63.4 [SD, 13.9] years and 63.7 [SD, 15.3] years for US-born and foreign-born Hispanics, respectively). Approximately 52% of the patients were born in the United States. A total of 54% of the patients were male and 57% were married. Approximately 35%, 39%, and 21% of US-born Hispanic patients with CRC and a similar 34%, 39%, and 22% of foreign-born Hispanic patients were diagnosed with localized, regional, and metastasized cancers, respectively (P value for difference, .21). Compared with US-born Hispanics, foreign-born Hispanic patients were more likely to be diagnosed after 2002 and to live in lower SES and higher Hispanic enclave neighborhoods ($P < .05$). Approximately 26% and 25% of the US-born Hispanics lived in the lowest SES and highest Hispanic enclave neighborhoods, respectively, compared with 35% and 39%, respectively, of the foreign-born Hispanic patients (Table 1).

With a mean follow-up of 4.8 years (± 5.0 years), the median overall survival was 5.9 years (95% CI, 5.7 years-6.0 years). Table 2 shows that compared with US-born Hispanic patients

with CRC, foreign-born Hispanics demonstrated significantly lower overall mortality (HR, 0.89; 95% CI, 0.85–0.92) and CRC-specific mortality (HR, 0.89; 95% CI, 0.85–0.94) after adjusting for neighborhood SES, Hispanic enclave, and other factors. Hispanics residing in lower SES neighborhoods experienced a higher rate of overall and CRC-specific mortality than those residing in high SES neighborhoods (*P* value for trend, .003). Specifically, compared with patients living in the highest SES neighborhoods, patients in the lowest SES neighborhoods had a 15% (95% CI, 1.06–1.26) increased rate of all-cause mortality and a 16% (95% CI, 1.03–1.30) increased rate of CRC-specific mortality. Although these findings suggested that Hispanics residing in neighborhoods with higher levels of Hispanic enclave were at an increased rate of mortality, this association was completely attenuated after adjusting for neighborhood SES (Table 2).

We observed heterogeneous associations between neighborhood SES and mortality rates by stage of disease at the time of diagnosis among Hispanic patients with CRC (*P* value for interaction, .046 and .03, respectively, for overall and CRC-specific mortality) (Table 3). Patients living in the lowest SES neighborhoods who were diagnosed with localized/regional CRC had an 18% and 25% greater risk of death from all causes and CRC, respectively, compared with patients in the highest SES neighborhoods (*P* value for trend, < .005), whereas no significant elevated risk was observed for patients diagnosed with metastasized CRC. In addition, heterogeneous associations between SES and mortality were observed by nativity (*P* value for interaction, .02 and .01, respectively, for overall and CRC-specific mortality) (Table 4). Among US-born Hispanics, there were highly significant inverse associations noted between neighborhood SES and all-cause and CRC-specific mortality (*P* value for trend < .001) such that US-born Hispanics living in the lowest SES neighborhoods had a 1.2-fold increased risk of overall and CRC-specific mortality compared with those living in the highest SES neighborhoods (*P* value for trend, < .001). Conversely, among foreign-born His-panics, no significant trends were observed between neighborhood SES and overall and CRC-specific mortality. We conducted sensitivity analyses by excluding the 765 Hispanic patients (379 who were US-born [1.1%] and 386 who were foreign-born [1.2%]) with missing or invalid SSNs and found that it did not affect our overall results.

DISCUSSION

In this large prospective study of 33,146 Hispanic patients with CRC from California, foreign-born Hispanics experienced a significantly lower rate of death from CRC and all causes compared with US-born Hispanics. Hispanics living in low SES neighborhoods had an increased risk of overall and CRC-specific mortality compared with those from high SES neighborhoods. Importantly, this inverse association between neighborhood SES and mortality risk for patients with CRC was considerably more pronounced in patients diagnosed with localized/regional CRC than those with metastasized CRC, as well as in US-born Hispanics compared with in foreign-born Hispanics.

The current study findings of inverse associations between SES and risk of CRC-specific and overall mortality among Hispanics are consistent with other studies that have examined this association among patients with CRC of all racial/ethnic groups combined in the United States.[5,9,10,25] We previously observed an association between higher neighborhood SES

and lower CRC incidence and mortality rates among the Hispanic population of California from 1988 to 2002.[7] With our more precise survival analysis, modeling time to death and adjustment of key explanatory factors, we have been able to clarify that the previously observed association between higher SES and a lower CRC mortality rate was entirely reflective of the SES relationship with CRC incidence, given our current finding of poorer survival associated with lower SES.

It is interesting to note that our finding of improved survival among foreign-born Hispanic patients with CRC supports previous studies that have described a Hispanic immigrant health advantage with survival after diagnoses of breast, prostate, and lung cancer.[18,26,27] This health advantage among Hispanic immigrants indicates the tendency for foreign-born Hispanics to have a better health advantage despite their unfavorable SES compared with US-born Hispanics.[28–30] There are several possible explanations for this observation. First, the improved survival in immigrants could be a result of the underascertainment of deaths or loss to follow-up. In the data from the current study, US-born Hispanics were found to have a shorter time interval between the date of last follow-up and the study end date compared with foreign-born Hispanics (average, 0.33 years in foreign-born Hispanics vs 0.81 years in US-born Hispanics), which would suggest that foreign-born patients may return to their native countries after a cancer diagnosis and die (a phenomena referred as “reverse migration”). However, we observed a similar association in sensitivity analyses when 1) excluding all patients who were censored and lost to follow-up (> 2 years between last follow-up date and the study end date), which included 250 US-born and 735 foreign-born Hispanics; or 2) changing the vital status of those patients with advanced stage disease to “deceased” among those lost to follow-up. This suggests the magnitude of emigration would not likely bias our observations. Second, selective migration of “healthy immigrants” may also play a role in the lower overall mortality observed in immigrants.[31–33] However, prior studies have shown that although the effect of “reverse migration” and the “healthy immigrants” may exist to some extent, they could only partially explain the Hispanic paradox.[28,29,32] Alternatively, this paradox could be due to a true health advantage among the Hispanic immigrants.

To our knowledge, the current study is the first to report that the magnitude of the neighborhood SES mortality disparity was more striking in US-born compared with foreign-born Hispanics. SES is an important prognostic determinant for most common cancers, including breast and prostate cancer.[25,34] Although to our knowledge there is no existing evidence to support such a disparity by nativity among Hispanic patients with CRC, it is likely that inequality in treatment may partially explain the substantial impact of neighborhood SES on CRC mortality. In the current study, we observed, among patients who were diagnosed with localized or regional CRC, evidence of an interaction between neighborhood SES and nativity on CRC-specific mortality (*P* value for interaction, .048) that was attenuated after adjusting for the first course of treatment, including surgery, chemotherapy, and radiotherapy (*P* value for interaction, .071). However, in our main analysis as well as stratified analyses by stage of disease at diagnosis and by nativity, the SES gradient on CRC mortality remained after adjusting for multiple patient and clinical characteristics including treatment, which would suggest that differences in neighborhood SES associations between US-born and foreign-born Hispanics is unlikely fully explained

by stage of disease at diagnosis, patients' demographic and clinical factors, and first course of treatment.

In addition to medical treatment, immigration-related factors may play an important role in the marked difference in SES associations observed between US-born and foreign-born Hispanics. Although foreign-born Hispanics are more likely to be of low SES with lower average levels of income and education, they also tend to have high levels of social cohesion and to retain cultural and behavioral norms, such as intact family structures and normative socialization, which provide support to residents against socioeconomic distress.[36–38] These social and cultural supports can be advantageous with respect to cancer survival. In addition, foreign-born Hispanics have been reported to possess favorable health behaviors, lifestyles, and attitudes toward health care and the use of traditional medicines that may mediate a survival benefit.[39–45] Conversely, US-born Hispanics have been found to be more assimilated to unfavorable US dietary, lifestyle, and health behaviors, such as physical inactivity, obesity, and smoking,[46–48] that may negatively impact their health outcomes. We examined the age-adjusted prevalence estimates of selected potential prognostic factors for CRC, including obesity, vegetable or fruit intake, cigarette smoking, and alcohol consumption[49–51] in Hispanics by nativity based on the 2009 California Health Interview Survey. We found that among US-born Hispanics, 32% were obese (with a body mass index of had ≥30), 57% ≥5 servings of vegetables or fruit daily, 32% were ever-smokers, and 42% reported binge drinking within the past year, whereas the corresponding figures in foreign-born Hispanics were 29%, 45%, 29%, and 27%, respectively, for obesity, vegetable or fruit intake, smoking, and binge drinking. These and other "Westernized lifestyle" factors may lead to poor survival outcomes among acculturated US-born Hispanics. Furthermore, although we did not observe a difference in the age-adjusted prevalence of diabetes, an established prognostic factor for CRC,[52] in the California Health Interview Survey, by Hispanic nativity, a higher prevalence of diabetes was observed in US-born compared with foreign-born Hispanics.[53] Given that low SES is associated with an increased risk of diabetes,[54] it is possible that the high prevalence of diabetes noted among US-born Hispanics living in low SES neighborhoods may lead to a higher mortality rate compared with foreign-born Hispanics residing in similar neighborhoods. Although to our knowledge the reasons underlying the modification effect of neighborhood SES on the association between nativity and cancer survival is unknown, our finding of a marked inverse association between neighborhood SES and mortality in US-born but not foreign-born Hispanic patients with CRC suggests that US-born Hispanics may experience more significant differences in terms of level of social support and adoption of the Westernized lifestyles and health behaviors across the neighborhood SES gradient compared with foreign-born Hispanics residing in similar neighborhoods.

The current study has distinct strengths of a population-based design and the power to detect variations in CRC mortality across neighborhood SES and nativity among Hispanics. Our comprehensive measure of SES includes several domains such as education, income, and employment, which capture various elements of the socioeconomic environment. In addition, our classification of Hispanic ethnicity was based on a validated method developed to enhance classification based on surnames, given names, and birthplace.[14] Our measurement of nativity, which relied on an imputation method for the 23% of patients with

CRC for whom there was missing registry data regarding birthplace, is also highly accurate in comparison with recorded registry birthplace[23] or death certificates.[22] There are limitations to the current study because we were unable to adjust for some clinical characteristics and lifestyle/demographic factors such as treatment beyond the first course of therapy, comorbidities, health behaviors, and individual-level SES. It is also worth noting that despite the significant difference in the modification effect of neighborhood SES on mortality by nativity, the associations between neighborhood SES and Hispanic enclave on overall and CRC-specific mortality in all Hispanic patients was not significant in the current study.

Neighborhood SES demonstrates differential effects on overall and CRC-specific mortality between US-born and foreign-born Hispanics. Further migrant studies are clearly needed to identify the underlying factors that drive survival advantages for CRC among this growing population of Hispanics in the United States.

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TABLE 1

Demographic and Clinical Characteristics for Hispanic Patients Diagnosed With Invasive CRC by Nativity: California, 1988 to 2010

Characteristic	All Cases (n = 33,146)	US-Born (n = 17,160)	Foreign-Born (n = 15,986)
Sociodemographic characteristics	No. (%)	No. (%)	No. (%)
Y of diagnosis			
1988–1992	4734 (14.3%)	2619 (15.3%)	2115 (13.2%)
1993–1997	5506 (16.6%)	3049 (17.8%)	2457 (15.4%)
1998–2002	7381 (22.3%)	3885 (22.6%)	3496 (21.9%)
2003–2007	9250 (27.9%)	4545 (26.5%)	4705 (29.4%)
2008–2010	6275 (18.9%)	3062 (17.8%)	3213 (20.1%)
Age at diagnosis, y			
<50	5711 (17.2%)	2751 (16.0%)	2960 (18.5%)
50–59	6808 (20.5%)	3543 (20.6%)	3265 (20.4%)
60–69	8409 (25.4%)	4709 (27.4%)	3700 (23.1%)
70–79	7561 (22.8%)	4135 (24.1%)	3426 (21.4%)
≥80	4657 (14.0%)	2022 (11.8%)	2635 (16.5%)
Sex			
Male	17,876 (53.9%)	9567 (55.8%)	8309 (52.0%)
Female	15,270 (46.1%)	7593 (44.2%)	7677 (48.0%)
Marital status at diagnosis			
Married	18,925 (57.1%)	9752 (56.8%)	9173 (57.4%)
Never married	4746 (14.3%)	2423 (14.1%)	2323 (14.5%)
Previously married	8220 (24.8%)	4394 (25.6%)	3826 (23.9%)
Unknown	1255 (3.8%)	591 (3.4%)	664 (4.2%)
Neighborhood SES			
Quintile 1 (low)	10,016 (30.2%)	4471 (26.1%)	5545 (34.7%)
Quintile 2	8228 (24.8%)	4241 (24.7%)	3987 (24.9%)
Quintile 3	6525 (19.7%)	3644 (21.2%)	2881 (18.0%)
Quintile 4	5036 (15.2%)	2890 (16.8%)	2146 (13.4%)
Quintile 5 (high)	3341 (10.1%)	1914 (11.2%)	1427 (8.9%)
Hispanic enclave			
Quintile 1 (low)	2195 (6.6%)	1519 (8.9%)	676 (4.2%)
Quintile 2	3585 (10.8%)	2264 (13.2%)	1321 (8.3%)
Quintile 3	4967 (15.0%)	2938 (17.1%)	2029 (12.7%)
Quintile 4	7699 (23.2%)	4033 (23.5%)	3666 (22.9%)
Quintile 5 (high)	10,516 (31.7%)	4254 (24.8%)	6262 (39.2%)
Unknown/missing	4184 (12.6%)	2152 (12.5%)	2032 (12.7%)
Clinical characteristics			
Tumor stage			
Localized	11,392 (34.4%)	6021 (35.1%)	5371 (33.6%)
Regional	13,022 (39.3%)	6762 (39.4%)	6260 (39.2%)

Characteristic	All Cases (n = 33,146)	US-Born (n = 17,160)	Foreign-Born (n = 15,986)
Metastasized	7106 (21.4%)	3670 (21.4%)	3436 (21.5%)
Unknown	1626 (4.9%)	707 (4.1%)	919 (5.7%)
Tumor grade			
Well differentiated	3151 (9.5%)	1640 (9.6%)	1511 (9.5%)
Moderately differentiated	19,480 (58.8%)	10,268 (59.8%)	9212 (57.6%)
Poorly/undifferentiated	5668 (17.1%)	2890 (16.8%)	2778 (17.4%)
Unknown	4847 (14.6%)	2362 (13.8%)	2485 (15.5%)
Tumor size, cm			
0–2.00	2840 (8.6%)	1569 (9.1%)	1271 (8.0%)
2.01–5.00	12,428 (37.5%)	6655 (38.8%)	5773 (36.1%)
>5.00	9001 (27.2%)	4514 (26.3%)	4487 (28.1%)
Microinvasion	48 (0.1%)	25 (0.1%)	23 (0.1%)
Unknown/missing	8829 (26.6%)	4397 (25.6%)	4432 (27.7%)
Surgery			
No	4497 (13.6%)	2118 (12.3%)	2379 (14.9%)
Yes	28,579 (86.2%)	15,016 (87.5%)	13,563 (84.8%)
Unknown	70 (0.2%)	26 (0.2%)	44 (0.3%)
Chemotherapy			
No	19,968 (60.2%)	10,322 (60.2%)	9646 (60.3%)
Yes	12,066 (36.4%)	6259 (36.5%)	5807 (36.3%)
Unknown	1112 (3.4%)	579 (3.4%)	533 (3.3%)
Radiotherapy			
No	28,220 (85.1%)	14,627 (85.2%)	13,593 (85.0%)
Yes	4884 (14.7%)	2519 (14.7%)	2365 (14.8%)
Unknown	42 (0.1%)	14 (0.1%)	28 (0.2%)

Abbreviations: CRC, colorectal cancer; SES, socioeconomic status.

TABLE 2

Overall and CRC-Specific Mortality Among Hispanics: California, 1988 to 2010[a]

	Overall Mortality				CRC-Specific Mortality			
	No. of Deaths (N=17,263)	**Model 1 + SES**	**Model 1+Hispanic Enclave**	**Model 1 +SES+ Hispanic Enclave**	**No. of Deaths (N=10,552)**	**Model 1 +SES**	**Model 1 +Hispanic Enclave**	**Model 1 +SES+ Hispanic Enclave**
Nativity								
US-born	9368	1.00 (reference)	1.00 (reference)	1.00 (reference)	5749	1.00 (reference)	1.00 (reference)	1.00 (reference)
Foreign-born	7895	**0.91 (0.88–0.94)**	**0.89 (0.85–0.92)**	**0.89 (0.85–0.92)**	4803	**0.90 (0.86–0.94)**	**0.89 (0.84–0.93)**	**0.89 (0.85–0.94)**
Neighborhood SES								
Quintile 5 (high)	1645	1.00 (reference)		1.00 (reference)	999	1.00 (reference)		1.00 (reference)
Quintile 4	2575	1.06 (0.99–1.14)		1.07 (0.98–1.16)	1567	1.05 (0.96–1.16)		1.06 (0.95–1.18)
Quintile 3	3396	**1.11 (1.04–1.19)**		**1.14 (1.05–1.24)**	2090	**1.11 (1.02–1.22)**		**1.17 (1.06–1.30)**
Quintile 2	4270	**1.11 (1.04–1.19)**		**1.10 (1.01–1.20)**	2638	**1.10 (1.01–1.20)**		**1.12 (1.01–1.25)**
Quintile 1 (low)	5377	**1.18 (1.10–1.26)**		**1.15 (1.06–1.26)**	3258	**1.13 (1.04–1.23)**		**1.16 (1.03–1.30)**
P for trend		<.0001		.0034		.0036		.0172
Hispanic enclave								
Quintile 5 (high)	5329		1.00 (reference)	1.00 (reference)	3280		1.00 (reference)	1.00 (reference)
Quintile 4	3818		**0.94 (0.89–0.98)**	0.95 (0.90–1.01)	2415		0.98 (0.92–1.04)	0.99 (0.92–1.06)
Quintile 3	2471		**0.93 (0.87–0.98)**	0.97 (0.90–1.03)	1537		0.96 (0.89–1.03)	1.00 (0.91–1.09)
Quintile 2	1767		**0.89 (0.84–0.95)**	0.95 (0.88–1.03)	1130		0.93 (0.86–1.01)	0.99 (0.90–1.09)
Quintile 1 (low)	1072		**0.88 (0.81–0.95)**	0.93 (0.85–1.02)	664		0.95 (0.86–1.05)	1.00 (0.89–1.12)
P for trend			<.0001	.1365			.0632	.9517

Abbreviations: CRC, colorectal cancer; SES, socioeconomic status.

[a]Model 1 was adjusted for year of diagnosis, age at diagnosis, sex, nativity, tumor grade, tumor size, and first course of treatment (surgery, chemotherapy, and radiotherapy); clustering effect by block group, stratified by stage at diagnosis. Bold type indicate significance.

TABLE 3

Overall and CRC-Specific Mortality Among Hispanics, Stratified by Stage at Diagnosis: California, 1988 to 2010[a]

	Overall Mortality					CRC-Specific Mortality				
	Localized/Regional		Metastasized			Localized/Regional		Metastasized		
	No. of Deaths (N=10,208)	HR (95% CI)	No. of Deaths (N=5867)	HR (95% CI)	*P* for Interaction	No. of Deaths (N=4863)	HR (95% CI)	HR (95% CI)		*P* for Interaction
Neighborhood SES										
Quintile 5 (high)	988	1.00 (reference)	548	1.00 (reference)	.0457	452	1.00 (reference)	471	1.00 (reference)	.0270
Quintile 4	1525	1.06 (0.95–1.17)	885	1.07 (0.92–1.23)		729	1.06 (0.92–1.23)	737	1.04 (0.89–1.22)	
Quintile 3	2038	**1.14 (1.03–1.26)**	1133	1.14 (0.99–1.32)		959	**1.18 (1.02–1.36)**	980	**1.18 (1.01–1.37)**	
Quintile 2	2508	**1.14 (1.03–1.27)**	1479	1.00 (0.86–1.16)		1200	**1.20 (1.04–1.39)**	1252	1.01 (0.86–1.18)	
Quintile 1 (low)	3149	**1.18 (1.06–1.32)**	1822	1.03 (0.88–1.20)		1523	**1.25 (1.07–1.46)**	1473	1.00 (0.84–1.18)	
P for trend		.0024		.7401			.0026		.5100	

Abbreviations: 95% CI, 95% confidence interval; CRC, colorectal cancer; HR, hazard ratio; SES, socioeconomic status.

[a]Cox regression models were adjusted for year of diagnosis, age at diagnosis, sex, nativity, Hispanic enclave, tumor grade, tumor size, and first course of treatment (surgery, chemotherapy, and radiotherapy); clustering effect by block group. Bold type indicate significance.

TABLE 4

Overall and CRC-Specific Mortality Among Hispanics, Stratified by Nativity: California, 1988 to 2010[a]

	Overall Mortality					CRC-Specific Mortality				
	US-Born		Foreign-Born			US-Born		Foreign-Born		
	No. of Deaths (N=9368)	HR (95% CI)	No. of Deaths (N=7895)	HR (95% CI)	*P* for Interaction	No. of Deaths (N=5749)	HR (95% CI)	No. of Deaths (N=4803)	HR (95% CI)	*P* for Interaction
Neighborhood SES										
Quintile 5 (high)	952	1.00 (reference)	693	1.00 (reference)	.0168	584	1.00 (reference)	415	1.00 (reference)	.0124
Quintile 4	1484	1.03 (0.94–1.13)	1091	1.10 (0.98–1.24)		894	1.02 (0.90–1.15)	673	1.11 (0.96–1.29)	
Quintile 3	1978	1.13 (1.03–1.23)	1418	1.09 (0.98–1.21)		1228	1.15 (1.02–1.29)	862	1.07 (0.92–1.23)	
Quintile 2	2345	1.16 (1.07–1.27)	1925	1.04 (0.94–1.16)		1447	1.18 (1.05–1.32)	1191	1.02 (0.89–1.17)	
Quintile 1 (low)	2609	1.21 (1.11–1.33)	2768	1.12 (1.02–1.24)		1596	1.20 (1.07–1.34)	1662	1.06 (0.93–1.21)	
P for trend		<.0001		.1244			<.0001		.9851	

Abbreviations: 95% CI, 95% confidence interval; CRC, colorectal cancer; HR, hazard ratio; SES, socioeconomic status.

[a]Cox regression model was adjusted for year of diagnosis, age at diagnosis, sex, tumor grade, tumor size, and first course of treatment (surgery, chemotherapy, and radiotherapy); clustering effect by block group, stratified by stage at diagnosis.