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Survival of Distinct Asian Groups Among Colorectal Cancer Cases in California

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Abstract

BACKGROUND—It has been reported that Asian ethnicity confers a survival benefit in colorectal cancer (CRC) compared with other ethnicities, but it is not known if this is limited to specific Asian subsets. In the current study, the authors attempted to determine differences using data from the large, population-based California Cancer Registry (CCR).

METHODS—The authors conducted a case-only analysis of CCR data (1994–2003), including descriptive analysis of relevant clinical variables. Overall survival univariate analyses were conducted using the Kaplan-Meier method. Multivariate survival analyses were performed using Cox proportional hazards ratios (HR).

RESULTS—The 61,494 incident cases of colon and 24,350 incident cases of rectal cancer analyzed included 1905 Chinese, 1162 Filipino, 414 Vietnamese, 391 Korean, 1091 Japanese, 148 Asian Indian, and 77,554 Caucasians. After adjustment for age, sex, grade, histology, site within the colon, stage of disease, insurance status, socioeconomic status (SES), and therapy, Filipino (colon: HR, 0.85; 95% confidence interval [95% CI], 0.76–0.95) (rectum: HR, 0.82; 95% CI, 0.71–0.94) and Chinese ethnicity (colon: HR, 0.90; 95% CI, 0.92–0.98) had significantly decreased risk of death compared with Caucasians. Sigmoid lesions were independently associated with improved survival among all cases (HR, 0.92; 95% CI, 0.88–0.95) (referent group were proximal and transverse lesions), and among Asian-only cases in separate analysis (HR, 0.78; 95% CI, 0.70–0.87).

CONCLUSIONS—Although survival after CRC diagnosis is improved for Asians in general, significant survival differences are observed only in specific Asian subsets. Data from the current

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study suggest that survival among Asians is less affected by SES or treatment disparities, and may be because of biologic factors.

Keywords

Asian; colorectal cancer; ethnicity; race; survival

Colorectal cancer (CRC) is the second leading cause of cancer death in the US. During 2008, an estimated 108,070 new cases of colon cancer and 40,740 cases of rectal cancer will be diagnosed.¹ Although 49,960 individuals will die of CRC, the survival of these patients is known to vary over major ethnic groups, with an advantage for Asians/Pacific Islanders that to our knowledge is not well understood.^{2–5} Asians and Pacific Islanders are often aggregated into a single category that may not accurately reflect unique characteristics of distinct Asian groups. Asians, as a whole, have improved survival compared with the other major races⁶; however, whether this is true for all Asian subgroups remains unknown. The state of California has a significant number of Asian American residents who come from varied ethnic backgrounds. By using the California Cancer Registry (CCR), from a period of 2000 to 2002, the age-adjusted mortality rates per 100,000 for CRC in Asians was noted to be 18 in males and 11.6 in females compared with Caucasian males (21.3) and females (15.7).⁵ This overall mortality difference is consistent with what we have previously reported.⁶ The reasons behind the survival difference, however, are poorly understood. In the current study, we attempted to determine the survival differences among Asian subsets in colon and rectal cancer, through a case-only analysis of data from the large, population-based CCR.

MATERIALS AND METHODS

Study Population

We performed a retrospective, case-only analysis of colorectal cases in the CCR database. CCR is part of the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program, and is the largest contiguous-area population-based cancer registry in the world^{7,8}; standardized data collection and quality control procedures have been in place since 1988.^{9–11} Case reporting is estimated at 99% for the entire state of California,¹² with follow-up completion rates exceeding 95%. Data were abstracted from medical and laboratory records by trained tumor registrars.¹³ Tumor site and histology were coded according to the International Classification of Diseases (ICD) for Oncology.¹⁴ Cases were identified using SEER primary site code (colon: 21041, 21043–21049; rectum: 21051, 21052) and stratified on cell type by ICD-O-3 histology codes (adenocarcinoma: 8010, 8020–8022, 8140–8145, 8210, 8211, 8220, 8221, 8230, 8231, 8260–8263; mucinous adenocarcinoma: 8470, 8480, 848; and other histologies).

SEER extent of disease and surgical staging variables were used to derive TNM data in accordance with the 2002 American Joint Committee on Cancer (AJCC) staging system as previously described.⁶ Data were obtained using the April 2007 CCR data file on 5669 incident colon and 2621 incident rectal cancer cases among Asians diagnosed from January 1994 through December 2003 with follow-up through March 2007, representing 30,904

person-years of follow-up. Recorded variables included age, sex, ethnicity, stage at presentation, histology, treatment during the first course of therapy, socioeconomic status (SES), and vital status. SES is denoted as a single index variable in CCR using statewide measures of education, income, and occupation from census data, as previously described.^{8,15–17}

The Asian subsets were defined as Chinese, Filipino, Vietnamese, Korean, Japanese, Other Southeast Asian (included: Laotian, Hmong, Cambodian/Kampuchean, and Thai), Other Asian (included: Hawaiian, Chamorro, Tahitian, Samoan, Tongan, Fiji Islander, Burmese, Indonesian, Asian not otherwise specified [NOS], and Pacific Islander NOS), and Asian Indian (included: Pakistani, Sri Lankan, Nepalese, Sikkimese, Bhutanese, and Bangladeshi).

Treatment during the first course of therapy was ascertained using available data from CCR to determine whether cases underwent surgical resection, radiation therapy, or chemotherapy. The date of last follow-up was either the date of death or the last date of contact. Limited comorbidity information was available for cases not receiving surgery, and recorded as “contraindicated due to other conditions.” Cause of death was recorded according to ICD criteria in effect at the time of death. Hospital registrars contacted cases annually, and CCR staff annually reviewed state death certificates to identify deceased registry cases.

Statistical Analysis

Life tables and Kaplan Meier curves were generated for race and SES categories, and curves were compared with the log-rank test. Multivariate survival analysis was used to calculate overall survival and CRC-specific survival using Cox proportional hazard ratios (HRs). Proportionality assumptions for the Cox regression models were tested. First, univariate log (–log[survival]) versus log of survival curves by race were plotted, which approximated parallel curves. Next, Schoenfeld residuals were plotted for each race/ethnic group, and these residual plots revealed approximately zero slope for each race/ethnic group over time. Thus, Cox proportional hazards regression models were used for the multivariate survival analyses. Each variable in the Cox model was included and subsequently excluded from the full Cox model to determine how it affected the other covariates in the model. The largest change in estimates was <10%; thus, the final Cox models included each covariate. Goodness of fit for the Cox models was assessed using the chi-squared statistic. Variables included in the full model are covariates that have been reported previously to have associations with mortality. Clinical characteristics were analyzed with Pearson chi-squared test or Fisher exact test for categorical variables, and the nonparametric Kruskal-Wallis test for comparison of continuous variables for more than 2 groups. For multiple comparisons, *P* values were not adjusted. All statistical analyses were conducted using SAS statistical software (version 9.1; SAS Institute, Inc, Cary, NC). Statistical significance was assumed for a 2-tailed *P* value <.05.

Ethical Considerations

This study involved analysis of de-identified data from CCR, without patient contact or identifiers. This study was approved by the University of California Irvine Institutional Review Board (IRB) under the category “exempt status” (IRB #2007-5842).

RESULTS

Demographic Characteristics

Table 1 shows the demographic and clinical data for the entire study population by cancer type. The cohort included 2615 Chinese (31.5%), 1810 Filipino (21.8%), 1561 Japanese (18.8%), 650 Korean (7.8%), 645 Other Asian (7.8%), 623 Vietnamese (7.5%), 218 Asian Indian (2.6%), and 168 Other Southeast Asian (2%). Rectal cancer patients were predominantly male (57.7%). Rectal cancer was more often stage I (31.3%) compared with colon cancer (21.4%), which was more often stage II (32.7%) (graded according to the American Joint Committee on Cancer grading system). The age distribution for colon cancer was older (49.9% 70+ years) compared with rectal cancer (39.1% 70+ years).

Demographic Characteristics by Ethnicity

Sex distribution was even among colon cancer cases (Table 2) except in Filipino (53%) and Japanese (55%), in which there was a female predominance. There was a male predominance (55%) in Vietnamese colon cancer cases ($P = .03$). In rectal cancer (Table 3), there was a male predominance in all groups except for Vietnamese, which was evenly distributed ($P = .035$). When compared with Caucasians, for both colon and rectal cancer, all the Asian subsets were more often diagnosed at a relatively younger age (<70 years) ($P < .0001$). In colon cancer, the Asian subsets (40%) had a greater proportion with distal disease (sigmoid colon) compared with Caucasians (31%). The Asian subsets also had 54% of their population with proximal disease, whereas Caucasians had 64% with proximal lesions ($P < .0001$). SES was varied among the subsets, with Asian Indians most often being in the highest quintile (44% colon, 36% rectum), whereas Vietnamese were in the highest quintile least often (15% colon and rectum) ($P < .0001$). Comparing standard therapy and ethnicity by stage (data not shown), there was no disparity in surgical intervention between ethnicities. However, the Asian subsets (except for Koreans in colon cancer) more often received chemotherapy as first-line treatment for stage IV disease in both colon ($P = .0002$) and rectal cancer ($P = 0.03$) compared with Caucasians.

Colorectal Cancer–specific Survival Analysis

Of 8290 Asian CRC cases in this study, 3320 (40%) died. 2291 of those died from CRC (69%). The majority of the other deaths were because of infection, unknown causes, or other causes (17.9%); heart disease (11%); and lung cancer (2%). The proportions of death because of CRC were: 67.5% in Chinese, 72.1% in Filipino, 74% in Vietnamese, 72.5% in Korean, 62.8% in Japanese, 76.9% in Other Southeast Asian, 72.3% in Other Asian, and 71% in Asian Indian individuals ($P = .02$).

Univariate CRC-specific survival (CRC-SS) analysis revealed significantly improved survival for Asians in colon cancer compared with Caucasians (Fig. 1) ($P = .008$), but not in

rectal cancer ($P = .37$). One-year, 5-year, and 10-year CRC-SS rates by ethnicity are reported separately for colon and rectal cancer in Table 4. Despite having similar 1-year CRC-SS estimates compared with other race/ethnic groups, Other Southeast Asian ethnicity was observed to have the lowest 5-year and 10-year CRC-SS estimates numerically, among colon and also rectal cancer cases. Asian Indians and Vietnamese were observed to have the highest 10-year CRC-specific survival estimates among colon and rectal cancer cases, respectively.

Among colon cancer cases, when compared with Caucasians, the only 2 groups to demonstrate significant differences were Chinese with 10% less risk of death (HR, 0.90; 95% confidence interval [CI], 0.92–0.98) and Filipino with 15% less risk of death (HR, 0.85; 95% CI, 0.76–0.95) after adjustment for age, sex, grade, histology, stage, insurance status, SES, colon site, and treatment (Table 5). In addition, there existed a nonsignificantly improved survival for Japanese (HR, 0.92; 95% CI, 0.82–1.03). By using proximal disease as the referent group, a survival benefit was observed for sigmoid colon lesions (HR, 0.92; 95% CI, 0.88–0.95). In rectal cancer, improved survival was again seen in Filipinos (HR, 0.82; 95% CI, 0.71–0.94) after adjustment for age, sex, grade, histology, stage, insurance status, SES, rectal site, and treatment. Whereas survival in Chinese was no longer significant, the trend toward improved survival remained in Japanese (HR, 0.84; 95% CI, 0.70–1.00). Disease in the rectosigmoid colon had a survival advantage (HR, 0.93; 95% CI, 0.88–0.98) compared with the rectum. Further analysis including Asian subsets only, with Chinese as the referent group, are presented in Table 5.

Restricting analysis of colon cancer cases to those who did not receive chemotherapy, Asians had improved CRC-SS compared with Caucasians after adjustment for each of the variables in the full Cox model overall (HR, 0.88; 95% CI, 0.81–0.94). This association with decreased CRC-specific mortality was limited to cases with stage I (HR, 0.73; 95% CI, 0.54–0.98) and stage IV (HR, 0.84; 95% CI, 0.75–0.94) colon cancer only. Among colon cancer cases receiving chemotherapy, Asian did not have statistically significant differences in the risk of CRC-specific mortality compared with Caucasians (HR, 0.95; 95% CI, 0.88–1.03), and there were no stage-specific CRC-SS differences for Caucasians versus Asians (data not shown).

DISCUSSION

Our population-based analysis of Asian CRC cases in California reveals improved cancer-specific survival for Chinese and Filipino individuals with colon cancer, whereas for rectal cancer this benefit is only noted in Filipinos. Asians, as compared with Caucasians, have improved CRC-specific survival for stage I and stage IV colon cancer among those not receiving chemotherapy. In addition, we find that Asians less often have proximal disease, and these results are consistent with previous reports.¹⁸ Furthermore, multivariate analyses reveal a survival benefit for sigmoid and rectosigmoid lesions. Overall, these data suggest that biologic factors may account for the survival improvement observed in Asians.

The current study results do not suggest a disparity in treatment between the Asian subgroups and Caucasians. Interestingly, SES and insurance status did not exert a

confounding effect on survival, nor did it correlate with the use of chemotherapy or radiation. Wong et al. previously reported few ethnic differences in CRC screening rates between Asian Americans and non-Latino whites.¹⁹ The basis of genetic, and epigenetic, alterations being central in the development of CRC was elucidated in a landmark review by Fearon and Vogelstein,²⁰ which has led to the concept of gene-environment interactions becoming prominent. This is well illustrated in studies that take into account nativity,²¹ in which factors such as diet, other exposures, and inherent characteristics may contribute to differences in incidence between early and late migrants and also between their descendants. Similar studies support the idea that adopting a Western diet may increase the risk of CRC incidence and mortality toward a risk level comparable to that of the new geographic demographic or even contribute to recurrence.²² Future gene-environment whole genome association and whole genome next-generation sequencing studies will address more precisely the nature of these interactions.

The importance of biology is suggested by our finding that the rate of distal colon cancer was higher in Asians compared with Caucasians, and that this was associated with a decreased risk of mortality. The variation in the incidence of CRC by tumor site and its association with geography, age, and sex led Bufill²³ to propose the existence of 2 distinct entities of CRC based on its origin in the large bowel. Further support for this is noted in the predominant distribution of the Lynch syndrome in the right colon and of familial adenomatous polyposis in the left colon. Differences by subsite have been reported in tumor suppressor genes, point mutations, and genetic instability.^{24,25} Specifically, it has been noted that left-sided colon lesions have a higher rate of chromosomal instability, whereas right-sided colon lesions more often demonstrate microsatellite instability (MSI).^{26,27} Azzoni et al. studied distinct molecular features of sporadic CRC patients and believed that the different patterns observed according to subsite could reflect different genetic pathways of carcinogenesis.²⁸ Understanding these mechanisms more completely should not only have therapeutic implications but preventive ones as well.

Pharmacogenomic differences between Asian subsets may explain the observed survival differences. Proximal cancers may represent a distinct molecular entity from that of distal cancers,²³ and the various Asian subsets reveal heterogeneity in tumor subsite location at diagnosis. This raises the question of whether there exists a preferential therapy-related survival benefit based on tumor subsite location. Previous studies of adjuvant therapy in Duke C (AJCC stage III disease equivalent) have reported a survival benefit with fluorouracil (5-FU)-based chemotherapy in CRC patients with wild-type TP53 and in those with MSI.²⁹ In addition, a previous in vitro study observed that proximal tumors more often had wild-type TP53, and that disruption of TP53 caused CRC cells to become resistant to 5-FU.³⁰ Another consideration is the possibility that certain Asian subset groups may respond better to other agents such as oxaliplatin or irinotecan because of genotypic differences.^{31,32} Lastly, interethnic differences have been noted in an epidermal growth factor receptor (EGFR) polymorphism that may correspond to a response with 5-FU plus oxaliplatin-based chemotherapy as well as the EGFR tyrosine kinase inhibitor gefitinib.³³

The current study is retrospective in nature and shares limitations of other population-based studies. On the basis of 2000 US Census Bureau data for California,³⁴ it is possible that our

observations of Asians being younger at diagnosis and a female predominance in Filipino and Japanese colon cancer cases may represent their respective underlying population distributions. Interestingly, this is untrue, however, for our observation of a male predominance in Vietnamese colon cancer cases. Limited comorbidity data are available in CCR, and details of recurrence are not available. The existence of disparities found in follow-up or surveillance has been highlighted in prior studies.^{35,36} There was no uniform standard protocol on how CRC patients were staged; thus, all the cases were analyzed using “best available stage” based on combined clinical and pathological staging data. There was no centralized review of pathologic specimens. Finally, because of incomplete data, we were unable to compare foreign-born to US-born characteristics.

In summary, our results suggest that genetic variation among different ethnic groups plays an important role in CRC in Asians, whether it is carcinogenesis or response to therapy, and that further progress in understanding these molecular mechanisms may have far-reaching preventive and therapeutic significance. It is our hope that these data help advance awareness of populations that may benefit from advocating improved preventive lifestyle practices. As mentioned above, it has now been shown that adherence to a Western dietary pattern is associated with decreased survival after diagnosis in lymph node-positive colon cancer patients.²² In addition, physical activity has been associated with decreased mortality in separate studies.^{37,38} However, it is not known if the effects of such lifestyle changes have particularly pronounced effects among specific ethnic groups. Indeed, such differences may underlie the differences in CRC-specific survival observed for various race/ethnic groups in our study, and this warrants further study. The identification of specific disease or tumor characteristics will allow us to increase the efficacy of our treatments and predict those patients who will benefit most from therapy. By studying inherent characteristics in the Asian population, further discovery of pharmacogenetic molecular markers may change the concept of tailored, individualized therapy.

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Figure 1.

Colorectal cancer-specific survival is shown by race/ethnicity, according to the California Cancer Registry, January 1994 through December 2003, with follow-up through March 2007. From bottom to top of the figure: solid line of normal width indicates Other Southeast Asian ($n = 103$); light gray solid line of normal width, Korean ($n = 391$); extra dark solid line of normal width, Caucasian ($n = 55,825$); light gray dashed line of normal width, Filipino ($n = 1162$); dashed line of normal width, Japanese ($n = 1091$); extra dark solid line of thick width, Chinese ($n = 1905$); extra dark dashed line of thick width, Vietnamese ($n = 414$); light gray solid line of thick width, Other Asian ($n = 455$); and extra dark dashed line of extra thick width, Asian Indian ($n = 148$) ($P = .008$).

Table 1

Demographic Characteristics of Asian Colorectal Cancer Cases by Colon Versus Rectum; Incidence Cases, January 1994 to December 2003

	Colon (n =5669)	Rectum (n =2621)	Total (N =8290)
Sex			
Male	2771 (48.9)	1512 (57.7)	4283 (51.7)
Female	2898 (51.1)	1109 (42.3)	4007 (48.3)
Age, y			
Birth to 39	176 (3.1)	115 (4.4)	291 (3.5)
40–49	444 (7.8)	291 (11.1)	735 (8.9)
50–59	857 (15.1)	556 (21.2)	1413 (17.0)
60–69	1365 (24.1)	635 (24.2)	2000 (24.1)
70+	2827 (49.9)	1024 (39.1)	3851 (46.5)
Race			
Chinese	1905 (33.6)	710 (27.1)	2615 (31.5)
Filipino	1162 (20.5)	648 (24.7)	1810 (21.8)
Vietnamese	414 (7.3)	209 (8.0)	623 (7.5)
Korean	391 (6.9)	259 (9.9)	650 (7.8)
Japanese	1091 (19.3)	470 (17.9)	1561 (18.8)
Other Southeast Asian	103 (1.8)	65 (2.5)	168 (2.0)
Other Asian	455 (8.0)	190 (7.3)	645 (7.8)
Asian Indian	148 (2.6)	70 (2.7)	218 (2.6)
Stage			
Stage I	1214 (21.4)	819 (31.3)	2033 (24.5)
Stage II	1852 (32.7)	662 (25.3)	2514 (30.3)
Stage III	1606 (28.3)	710 (27.1)	2316 (27.9)
Stage IV	965 (17.0)	405 (15.5)	1370 (16.5)
Histologic subtype			
Adenocarcinoma	5020 (88.6)	2389 (91.2)	7409 (89.4)
Mucinous adenocarcinoma	561 (9.9)	171 (6.5)	732 (8.8)
Other	88 (1.6)	61 (2.3)	149 (1.8)
Histologic grade			
Low	4419 (78.0)	2091 (79.8)	6510 (78.5)
High	1250 (22.1)	530 (20.2)	1780 (21.5)
Colon site			
Proximal and transverse	2783 (49.1)	—	2783 (33.6)
Descending	445 (7.9)	—	445 (5.4)
Sigmoid	2441 (43.1)	—	2441 (29.4)
Rectosigmoid	—	914 (34.9)	914 (11.0)
Rectum	—	1707 (65.1)	1707 (20.6)
Socioeconomic status			
Lowest	721 (12.7)	326 (12.4)	1047 (12.6)

	Colon (n =5669)	Rectum (n =2621)	Total (N =8290)
Second lowest	994 (17.5)	464 (17.7)	1458 (17.6)
Middle	1090 (19.2)	521 (19.9)	1611 (19.4)
High	1354 (23.9)	630 (24.0)	1984 (23.9)
Highest	1510 (26.6)	680 (25.9)	2190 (26.4)

Demographic Information for Colon Cancer by Race; Incidence Cases, January 1994 to December 2003

Table 2

	Chinese (n =1905)	Filipino (n =1162)	Vietnamese (n =414)	Korean (n =391)	Japanese (n =1091)	Other Southeast Asian (n =103)	Other Asian (n =455)	Asian Indian (n =148)	Caucasian (n =55,825)	Total (N =61,494)
Sex										
Male	956 (50)	551 (47)	229 (55)	191 (49)	489 (45)	52 (51)	226 (50)	77 (52)	27,320 (49)	30,091 (49)
Female	949 (50)	611 (53)	185 (45)	200 (51)	602 (55)	51 (49)	229 (50)	71 (48)	28,505 (51)	31,403 (51)
Age, y										
Birth to 39	37 (2)	43 (3.3)	25 (6)	12 (3.1)	13 (1.2)	10 (9.7)	25 (5.5)	11 (7.4)	915 (2)	1091 (2)
40-49	123 (7)	107 (9)	53 (13)	35 (9)	53 (5)	15 (15)	39 (9)	19 (13)	2573 (5)	3017 (5)
50-59	229 (12)	222 (19)	91 (22)	70 (18)	113 (10)	23 (22)	77 (17)	32 (22)	6250 (11)	7107 (12)
60-69	431 (23)	268 (23)	105 (25)	106 (27)	274 (25)	25 (24)	120 (26)	36 (24)	11,525 (21)	12,890 (21)
70+	1085 (57)	522 (45)	140 (34)	168 (43)	638 (59)	30 (29)	194 (43)	50 (34)	34,562 (62)	37,389 (61)
Stage										
Stage I	436 (23)	219 (19)	73 (18)	94 (24)	237 (22)	13 (13)	115 (25)	27 (18)	12,775 (23)	13,989 (23)
Stage II	648 (34)	365 (31)	130 (31)	133 (34)	337 (31)	36 (35)	145 (32)	58 (39)	19,820 (36)	21,672 (35)
Stage III	512 (27)	351 (30)	123 (30)	97 (25)	336 (31)	33 (32)	116 (26)	38 (26)	13,708 (25)	15,314 (25)
Stage IV	298 (16)	223 (19)	86 (21)	65 (17)	173 (16)	20 (19)	75 (17)	25 (17)	9039 (16)	10,004 (16)
Histologic grade										
Low	1507 (79)	884 (76)	310 (75)	311 (80)	855 (78)	84 (82)	352 (77)	116 (78)	43,350 (78)	47,769 (78)
High	398 (21)	278 (24)	104 (25)	80 (2)	236 (22)	19 (18)	103 (23)	32 (22)	12,475 (22)	13,725 (22)
Histologic subtype										
Adenocarcinoma	1684 (88)	1030 (89)	352 (85)	360 (92)	983 (90)	88 (85)	391 (86)	132 (89)	48,308 (87)	53,328 (87)
Mucinous adenocarcinoma	202 (11)	110 (9)	51 (12)	29 (7)	94 (9)	12 (12)	54 (12)	9 (6)	6412 (12)	6973 (11)
Other	19 (1)	22 (2)	11 (3)	2 (0.5)	14 (1)	3 (3)	10 (2)	7 (5)	1105 (2)	1193 (2)
Colon site										
Proximal and transverse	974 (51)	483 (42)	205 (50)	200 (51)	578 (53)	56 (54)	214 (47)	73 (49)	35,476 (64)	38,259 (62)
Descending	149 (8)	108 (9)	39 (9)	23 (6)	76 (7)	4 (4)	39 (9)	7 (5)	3268 (6)	3713 (6)
Sigmoid	782 (41)	571 (49)	170 (41)	168 (43)	437 (40)	43 (42)	202 (44)	68 (46)	17,081 (31)	19,522 (32)
Socioeconomic status										
Lowest	228 (12)	129 (11)	73 (18)	92 (24)	105 (10)	43 (42)	39 (9)	12 (8)	6139 (11)	6860 (11)

	Chinese (n =1905)	Filipino (n =1162)	Vietnamese (n =414)	Korean (n =391)	Japanese (n =1091)	Other Southeast Asian (n =103)	Other Asian (n =455)	Asian Indian (n =148)	Caucasian (n =55,825)	Total (N =61,494)
Second lowest	294 (15)	243 (21)	109 (26)	77 (20)	178 (16)	19 (19)	61 (13)	13 (9)	10,130 (18)	11,124 (18)
Middle	302 (16)	298 (26)	87 (21)	54 (14)	217 (20)	12 (12)	94 (21)	26 (18)	12,514 (22)	13,604 (22)
High	444 (23)	266 (23)	82 (20)	70 (18)	322 (30)	12 (12)	126 (28)	32 (22)	13,135 (24)	14,489 (24)
Highest	637 (33)	226 (19)	63 (15)	98 (25)	269 (25)	17 (17)	135 (30)	65 (44)	13,907 (25)	15,417 (25)
Surgery										
No	63 (3)	45 (4)	14 (3)	24 (6)	29 (3)	4 (4)	16 (4)	9 (6)	1951 (4)	2155 (4)
Yes	1842 (97)	1117 (96)	400 (97)	367 (94)	1062 (97)	99 (96)	439 (96)	139 (94)	53,871 (96)	59,336 (96)
Chemotherapy as first-line										
No	1327 (70)	701 (60)	224 (54)	277 (71)	722 (66)	66 (64)	307 (67)	87 (59)	40,032 (72)	43,743 (71)
Yes	578 (30)	461 (40)	190 (46)	114 (29)	369 (34)	37 (36)	148 (33)	61 (41)	15,793 (28)	17,751 (29)
Radiation										
No	1859 (98)	1121 (96)	402 (97)	375 (96)	1062 (97)	99 (96)	445 (98)	145 (98)	54,715 (98)	60,223 (98)
Yes	46 (2)	41 (4)	12 (3)	16 (4)	29 (3)	4 (4)	10 (2)	3 (2)	1110 (2)	1271 (2)

Demographic Information for Rectal Cancer by Race; Incidence Cases, January 1994 to December 2003

Table 3

	Chinese (n =710)	Filipino (n =648)	Vietnamese (n =209)	Korean (n =259)	Japanese (n =470)	Other Southeast Asian (n =65)	Other Asian (n =190)	Asian Indian (n =70)	Caucasian (n =21,729)	Total (N =24,350)
Sex										
Male	413 (58)	382 (59)	103 (49)	140 (54)	264 (56)	40 (62)	121 (64)	49 (70)	12,347 (57)	13,859 (57)
Female	297 (42)	266 (41)	106 (51)	119 (46)	206 (44)	25 (38)	69 (36)	21 (30)	9382 (43)	10,491 (43)
Age, y										
Birth to 39	19 (3.1)	27 (4.3)	20 (10)	9 (3)	12 (2)	5 (8)	14 (7)	9 (13)	558 (2)	673 (3)
40-49	77 (11)	82 (13)	36 (17)	22 (9)	24 (5)	15 (23)	26 (14)	9 (13)	1653 (8)	1944 (8)
50-59	148 (21)	140 (22)	33 (16)	77 (30)	78 (17)	20 (31)	41 (22)	19 (27)	3599 (17)	4155 (17)
60-69	144 (20)	171 (26)	49 (23)	84 (32)	127 (27)	14 (21)	42 (22)	4 (6)	5307 (24)	5942 (24)
70+	322 (45)	228 (35)	71 (34)	67 (26)	229 (49)	11 (17)	67 (35)	29 (41)	10,612 (49)	11,636 (48)
Stage										
Stage I	236 (33)	177 (28)	63 (30)	78 (30)	162 (35)	15 (23)	69 (37)	19 (27)	7670 (35)	8489 (35)
Stage II	183 (26)	158 (24)	57 (28)	67 (26)	120 (26)	23 (35)	36 (19)	18 (26)	5752 (27)	6414 (27)
Stage III	190 (27)	177 (28)	59 (29)	71 (28)	122 (26)	16 (25)	52 (28)	23 (33)	4871 (23)	5581 (23)
Stage IV	97 (14)	129 (20)	26 (13)	42 (16)	61 (13)	11 (17)	29 (16)	10 (14)	3195 (15)	3600 (15)
Histologic grade										
Low	565 (80)	523 (81)	161 (77)	203 (78)	381 (81)	47 (72)	153 (80)	58 (83)	17,931 (83)	20,022 (82)
High	145 (20)	125 (19)	48 (23)	56 (22)	89 (19)	18 (28)	37 (20)	12 (17)	3798 (17)	4328 (18)
Histologic subtype										
Adenocarcinoma	653 (92)	585 (90)	179 (86)	239 (92)	439 (93)	55 (85)	177 (93)	62 (89)	19,774 (91)	22,163 (91)
Mucinous adenocarcinoma	45 (6)	39 (6)	25 (12)	16 (6)	26 (6)	6 (9)	11 (6)	3 (4)	1415 (6)	1586 (6)
Other	12 (2)	24 (4)	5 (2)	4 (2)	5 (1)	4 (6)	2 (1)	5 (7)	540 (3)	601 (3)
Colon site										
Rectosigmoid	254 (36)	211 (33)	77 (37)	80 (31)	183 (39)	14 (22)	73 (38)	22 (31)	7512 (35)	8426 (35)
Rectum	456 (64)	437 (67)	143 (63)	179 (69)	287 (61)	51 (78)	117 (62)	48 (69)	14,217 (65)	15,924 (65)
Socioeconomic status										
Lowest	71 (10)	93 (15)	31 (15)	42 (16)	41 (9)	17 (26)	25 (13)	6 (8)	2799 (13)	3125 (13)
Second Lowest	92 (13)	112 (17)	59 (28)	50 (19)	91 (19)	16 (25)	34 (18)	10 (14)	4174 (19)	4638 (19)

	Chinese (n =710)	Filipino (n =648)	Vietnamese (n =209)	Korean (n =259)	Japanese (n =470)	Other Southeast Asian (n =65)	Other Asian (n =190)	Asian Indian (n =70)	Caucasian (n =21,729)	Total (N =24,350)
Middle	119 (17)	169 (26)	46 (22)	33 (13)	96 (20)	17 (26)	30 (16)	11 (16)	4741 (22)	5262 (22)
High	191 (27)	150 (23)	41 (20)	54 (21)	119 (25)	4 (6)	53 (28)	18 (26)	4984 (23)	5614 (23)
Highest	237 (33)	124 (19)	32 (15)	80 (31)	123 (27)	11 (17)	48 (25)	25 (36)	5031 (23)	5711 (23)
Surgery										
No	48 (7)	76 (12)	15 (7)	21 (8)	35 (7)	12 (18)	13 (7)	5 (7)	1974 (9)	2199 (9)
Yes	662 (93)	572 (88)	194 (93)	238 (92)	435 (93)	53 (82)	177 (93)	65 (93)	19,753 (91)	22,149 (91)
Chemotherapy as first-line treatment										
No	388 (55)	311 (48)	103 (49)	116 (45)	248 (53)	26 (40)	101 (53)	30 (43)	12,547 (58)	13,870 (57)
Yes	322 (45)	337 (52)	106 (51)	143 (55)	222 (47)	39 (60)	89 (47)	40 (57)	9182 (42)	10,480 (43)
Radiation										
No	462 (65)	371 (57)	144 (69)	144 (56)	299 (64)	30 (46)	124 (65)	44 (63)	14,219 (65)	15,837 (65)
Yes	248 (35)	277 (43)	65 (31)	115 (44)	171 (36)	35 (54)	66 (35)	26 (37)	7510 (35)	8513 (35)

Colorectal Cancer-specific Survival Estimates at Specified Time Points After an Incident Diagnosis of Colon or Rectal Cancer, Stratified by Race/
Ethnicity; California Cancer Registry, January 1994 to December 2003, With Follow-up Through March 2007

Table 4

Colon Cancer				Rectal Cancer			
Race/Ethnicity	1-Year CRC-SS	5-Year CRC-SS	10-Year CRC-SS	Race/Ethnicity	1-Year CRC-SS	5-Year CRC-SS	10-Year CRC-SS
Chinese (n = 1905)	88%	72%	68%	Chinese (n = 710)	91%	71%	63%
Filipino (n = 1162)	89%	70%	67%	Filipino (n = 648)	88%	66%	60%
Vietnamese n = 414)	88%	72%	69%	Vietnamese (n = 209)	92%	73%	69%
Korean (n = 391)	86%	68%	64%	Korean (n = 259)	91%	69%	62%
Japanese (n = 1091)	88%	70%	67%	Japanese (n = 470)	92%	73%	68%
Other Southeast Asian (n = 103)	89%	59%	55%	Other Southeast Asian (n = 65)	84%	65%	50%
Other Asian (n = 455)	89%	75%	73%	Other Asian (n = 190)	91%	69%	66%
Asian Indian (n = 148)	91%	76%	74%	Asian Indian (n = 70)	87%	72%	68%
Caucasian (n = 55,825)	86%	70%	66%	Caucasian (n = 21,729)	89%	69%	63%

CRC-SS indicates colorectal cancer-specific survival.

Table 5

Multivariate Colorectal Cancer–specific Survival Analysis for Colon and Rectum by Ethnicity, Using Cox Proportional Hazards Models: January 1994 to December 2003, With Follow-up Through March 2007

	Colon, HR (95% CI)	Rectum, HR (95% CI)	Colon and Rectum, HR (95% CI)
Race			
Caucasian	1.00 (Reference)	1.00 (Reference)	Asian subset only
Chinese	0.90 (0.92–0.98)	1.00 (0.87–1.16)	1.00 (Reference)
Filipino	0.85 (0.76–0.95)	0.82 (0.71–0.94)	0.89 (0.79–1.00)
Vietnamese	0.90 (0.75–1.09)	0.96 (0.73–1.25)	0.96 (0.81–1.14)
Korean	1.10 (0.91–1.32)	0.84 (0.67–1.06)	1.07 (0.91–1.26)
Japanese	0.92 (0.82–1.03)	0.84 (0.70–1.00)	0.97 (0.85–1.09)
Other Southeast Asian	1.22 (0.88–1.67)	1.02 (0.67–1.55)	1.18 (0.90–1.55)
Other Asian	0.87 (0.72–1.06)	1.07 (0.82–1.40)	0.97 (0.82–1.15)
Asian Indian	0.87 (0.61–1.24)	0.98 (0.61–1.55)	0.91 (0.68–1.22)
Colon site			
Proximal and transverse	1.00 (Reference)		1.00 (Reference)
Descending	0.99 (0.93–1.06)		0.97 (0.80–1.16)
Sigmoid	0.92 (0.88–0.95)		0.78 (0.70–0.87)
Rectosigmoid		0.93 (0.88–0.98)	0.89 (0.77–1.03)
Rectum		1.00 (Reference)	0.93 (0.81–1.08)
Surgery			
None	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Any	0.36 (0.34–0.38)	0.33 (0.31–0.35)	0.41 (0.35–0.47)
Radiation			
None	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Any	1.34 (1.23–1.45)	0.96 (0.91–1.02)	1.06 (0.92–1.22)
Chemotherapy			
None	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Any	0.80 (0.77–0.83)	0.77 (0.73–0.82)	0.86 (0.78–0.95)

HR indicates hazards ratio; 95% CI, 95% confidence interval.

Each model includes adjustment for age at diagnosis, sex, histologic grade, histology, stage, insurance status, and socioeconomic status.

$P < .0001$ for the entire model.