SHORT COMMUNICATION

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Comparative analysis of lifestyle factors, screening test use, and clinicopathologic features in association with survival among Asian Americans with colorectal cancer

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Background: Colorectal cancer (CRC) diagnoses and disease-specific survival (DSS) vary between ethnic groups in the United States. However, few studies have assessed differences among Asian subgroups.

Methods: The Surveillance, Epidemiology, and End Results (SEER) database was used to identify patients with invasive CRC between 1988 and 2008. Differences in clinicopathologic features, and DSS rates were compared among Asian subgroups. The California Health Interview Survey was used to examine risk factors and screening patterns for CRC.

Results: The study included 359 374 patients with 8.4% Asian. Patients in all Asian subgroups were younger (median: 68 years) at diagnosis than non-Hispanic white (NHW) patients (median: 72 years). Most Asian subgroups, except Hawaiians, had better DSS than NHW patients although Asian subgroups had more advanced disease than NHW. Indian/Pakistani patients had a higher 5-year DSS than other Asian subgroups. Obesity proportions were lower in Asian subgroups (<50.2%) than in NHW (59.8%). Vietnamese men and Korean women had the lowest proportions of CRC screening. Advance tumour stages were highly associated with worse DSS in each ethnicity group. High tumour grades were associated with worse DSS in NHW, Filipino, and Chinese. Older age at diagnosis was associated with worse DSS in most ethnicity groups except Hawaiian and Vietnamese.

Conclusion: Disparities exist between Asians and NHW with CRC, and among various Asian subgroups. Differences in cancer clinicopathologic features, patients' behavioural habits, lifestyle, and screening patterns may explain some differences in CRC survival observed among ethnic groups.

Asian Americans constitute the fastest growing ethnic group in the United States (American community survey, 2007). Colorectal cancer (CRC) is the third most common malignancy and the third most frequent cause of cancer death in the United States for overall population, although both incidence and mortality rates have declined in recent years (Cress *et al*, 2006).

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Some studies have discussed the incidence of and mortality rates differences between Asian Americans and other ethnic groups, but few examined disparities among Asian subgroup populations (Chien *et al*, 2005; White *et al*, 2010). The purpose of this analysis was to determine whether there are significant differences in presentation, clinicopathologic features, treatment, and survival rates between non-Hispanic white (NHW) and Asian; and between Asian subgroups in patients with CRC. In addition, lifestyle factors and screening prevalence were analysed to determine whether any disparities exist between the Asian subgroups and other ethnic groups residing in the United States and to explore the potential associations among these difference.

MATERIALS AND METHODS

Patient selection and data collection. The Surveillance, Epidemiology, and End Results (SEER) database of the National Cancer Institute was used to identify patients who were diagnosed with invasive primary CRC between 1988 and 2008. Data were obtained from all 17 US cancer registries participating in the SEER programme using SEER*Stat version 7.0.5 under a data user agreement (http://seer.cancer.gov/seerstat, access date: 23 January 2012). We included patients with invasive CRC with race coded as 'White' and 'Asian or Pacific Islander,' and 'Non-Spanish-Hispanic-Latino'.

Ethnicity was categorised into two broad groups: NHW and Asians (including Pacific Islanders). Asian ethnic groups were further categorised into the following eight subgroups: Filipino, Chinese, Japanese, Indian/Pakistani, Korean, Vietnamese, Hawaiian/Pacific Islander, and others.

Information on the prevalence of selected lifestyle factors for cancer and the use of CRC screening tests (colonoscopy and faecal occult blood testing) were derived from the 2009 California Health Interview Survey (CHIS) data using the askCHIS tool (http://ask.chis.ucla.edu/main/default.asp, access date: 17 February 2012). The CHIS is a state-wide telephone survey that was modelled after the National Health Interview Survey and was designed to provide population-based estimates for United States civilian, noninstitutionalised Californians. The information was only available for Chinese, Japanese, Korean, Filipino, and Vietnamese subgroups.

The χ^2 test was used to assess differences in patient characteristics, patient management, and outcomes among the two broad ethnic groups and among the eight Asian subgroups. The primary end point of this study is disease-specific survival (DSS), which was calculated as the number of years between the date of diagnosis and the date of CRC-related death, date last known to be alive, or 31 December 2008. Patients not experiencing this end point were censored at last follow-up. Multivariate Cox proportional hazards models were used to determine the influence of patient, tumour, and treatment factors (age at diagnosis, gender, year of diagnosis, median household income, ethnicity, tumour stage, tumour grade, tumour primary site, and primary surgery) of known or potential prognostic value on DSS. Stata SE version 10.0 statistical software (StataCorp LP, College Station, TX, USA) was used for statistical analyses. All tests were two-tailed, and statistical significance was set at $P<0.05$.

RESULTS

Patient and tumour characteristics. We included 359 374 patients with CRC: 329 250 (91.6%) NHWs and 30 124 (8.4%) Asians. Table 1 presents the comparisons among two broad ethnic groups (NHW and Asian). Asian patients were significantly younger at diagnosis (median: 68 years) than NHW patients (median: 72 years). A greater percentage of Asian patients were diagnosed with stage III disease (30.5%) than NHW (25.8%).

Table 2 displays results from the comparisons among eight subgroups in the Asian cohort: Filipino (19.1%), Japanese (26.9%), Chinese (23.9%), Hawaiian/Pacific Islander (6.9%), Korean (7.5%), Indian/Pakistani (3.0%), Vietnamese (5.6%), and others (7.1%). Indian/Pakistani patients were the youngest at diagnosis (median age: 60.5 years) and Japanese patients were the oldest

Table 1. Comparison of patient, tumour, and treatment characteristics among non-Hispanic white and Asian population in patients with colorectal cancer ($n=430\,625$)

Characteristic	Non-Hispanic white ($n=329\,250$)	Asian ($n=30\,124$)
Age at diagnosis (years)		
Mean	70.3	66.3
Median (range)	72 (9–108)	68 (12–104)
<40	5323 (1.6)	1079 (3.6)
40–64	85 962 (26.7)	10 490 (35.6)
65+	231 052 (71.7)	17 863 (60.7)
Sex		
Female	162 360 (49.3)	14 235 (47.2)
Male	166 890 (50.7)	15 889 (52.8)
Marital status at diagnosis		
Married	185 941 (58.4)	19 816 (67.4)
Other	132 494 (41.6)	9 625 (32.6)
Unknown	10 815	683
Stage		
I	81 480 (24.7)	6947 (23.1)
II	99 391 (30.2)	8234 (27.3)
III	84 983 (25.8)	9173(30.5)
IV	63 396 (19.3)	5770 (19.1)
Surgery on primary		
Not performed	23 310 (7.1)	2038 (6.8)
Performed	305 678 (92.9)	28 078 (93.2)
Unknown	262	8
Primary site		
Proximal colon	164 936 (50.1)	11 855 (39.4)
Sigmoid colon	70 175 (21.3)	8375 (27.8)
Rectum	83 997 (25.5)	9185 (30.5)
Others	10 142 (3.1)	709 (2.3)
Tumour grade		
I	29 169 (9.8)	2126 (7.7)
II	203 161 (68.2)	20 264 (73.1)
III	62 354 (20.9)	5168 (18.6)
Undifferentiated	3387 (1.1)	172 (0.6)
Unknown	31 179	2394
Median household income (in 10 $)		
Mean	4784.4	5126.6
Median (range)	4644 (1581–7989)	4982 (933–7989)

Table 2. Comparison of patient, tumour, and treatment characteristics among subgroups in the Asian cohort in patients with colorectal cancer ($n = 30\,124$)

Characteristic	Filipino ($n = 5764$)	Japanese ($n = 8105$)	Chinese ($n = 7213$)	Hawaiian ($n = 2070$)	Korean ($n = 2257$)	Indian/ Pakistani ($n = 900$)	Vietnamese ($n = 1690$)	Other ($n = 2125$)
Age at diagnosis (years)								
Mean	65.3	69.8	68.3	61.6	64.3	59.6	61.5	62.4
Median (range)	66 (12–100)	71 (23–100)	70 (17–102)	62 (12–96)	65 (17–97)	60.5 (18–96)	62 (19–98)	63 (14–97)
<40	212 (3.8)	115 (1.5)	188 (2.7)	137 (6.8)	85 (3.9)	79 (9.0)	124 (7.4)	139 (6.7)
40–64	2222 (39.5)	2076 (26.3)	2153 (30.4)	966 (48.3)	909 (41.4)	439 (50.1)	787 (47.3)	938 (45.0)
65+	3193 (56.8)	5710 (72.3)	4739 (66.9)	899 (44.9)	1201 (54.7)	359 (40.9)	754 (45.3)	1008 (48.4)
Sex								
Female	2599 (45.1)	3886 (47.9)	3487 (48.3)	914 (44.1)	1089 (48.2)	387 (43.0)	818 (48.4)	1055 (49.6)
Male	3165 (54.9)	4219 (52.1)	3726 (51.7)	1156 (55.9)	1167 (51.8)	513 (57.0)	872 (51.6)	1070 (50.3)
Marital status at diagnosis								
Married	3921 (69.5)	5003 (62.8)	4972 (70.5)	1176 (58.4)	1573 (71.3)	667 (76.3)	1089 (66.4)	1415 (69.0)
Other	1723 (30.5)	2958 (37.2)	2079 (29.5)	838 (41.6)	634 (28.7)	207 (23.7)	550 (33.6)	636 (31.0)
Unknown	120	144	162	56	50	26	51	74
Stage								
I	1247 (21.6)	2013 (24.8)	1671 (23.2)	428 (20.7)	495 (21.9)	193 (21.4)	351 (20.8)	549 (25.8)
II	1471 (25.5)	2268 (28.0)	2088 (28.9)	514 (26.1)	612 (27.1)	246 (27.3)	475 (28.1)	533 (25.1)
III	1809 (31.4)	2459 (30.3)	2122 (29.4)	613 (29.6)	743 (32.9)	279 (31.0)	503 (29.8)	645 (30.4)
IV	1237 (21.5)	1365 (16.8)	1332 (18.5)	488 (23.6)	407 (18.1)	182 (20.2)	361 (21.3)	398 (18.7)
Surgery on primary								
Not performed	492 (8.5)	436 (5.4)	426 (5.9)	183 (8.8)	147 (6.5)	76 (8.4)	109 (6.4)	169 (8.0)
Performed	5269 (91.5)	7669 (94.6)	6785 (94.1)	1886 (91.2)	2109 (93.5)	824 (91.6)	1581 (93.6)	1955 (92.0)
Unknown	3	0	0	1	1	0	0	1
Primary site								
Proximal colon	1907 (33.1)	3499 (43.2)	3033 (42.1)	802 (38.7)	807 (35.7)	331 (36.8)	655 (38.8)	821 (38.6)
Sigmoid colon	1726 (29.9)	2190 (27.0)	2028 (28.1)	524 (25.3)	606 (26.9)	239 (26.6)	457 (27.0)	605 (28.5)
Rectum	1987 (34.5)	2254 (27.8)	1999 (27.7)	672 (32.5)	795 (35.2)	299 (33.2)	539 (31.9)	640 (30.1)
Others	144 (2.5)	162 (2.0)	153 (2.1)	72 (3.5)	49 (2.2)	31 (3.4)	39 (2.3)	59 (2.8)
Tumour grade								
I	425 (8.1)	567 (7.5)	457 (6.9)	147 (7.8)	175 (8.3)	81 (9.8)	102 (6.5)	172 (8.9)
II	3807 (72.1)	5766 (76.6)	4825 (72.8)	1413 (75.1)	1463 (69.9)	565 (68.3)	1088 (69.7)	1339 (69.5)
III	1.011 (19.1)	1167 (15.5)	1295 (19.5)	314 (16.7)	444 (21.2)	172 (20.8)	361 (23.2)	404 (21.0)
Undifferentiated	37 (0.7)	30 (0.4)	53 (0.8)	8 (0.4)	12 (0.6)	9 (1.1)	10 (0.6)	13 (0.7)
Unknown	484	575	583	188	163	73	131	197
Median household income (in 10 $)								
Mean	5133.8	4974.8	5299.9	4936.9	4896.2	5456.6	5443.5	5155.5
Median (range)	4982 (2426–7734)	4982 (1956–7989)	5522 (2274–7989)	4982 (933–7734)	4289 (2986–7989)	5595 (2315–7989)	5316 (2713–7734)	5191 (1906–7989)

(median age: 71 years). The proportion of patients who had proximal colon cancer was much higher in the Japanese group (43.2%) than in other subgroups.

Risk factors and screening behaviours. Overweight and obesity proportions in Asian subgroups were much lower than in NHW (Table 3). The CRC screening proportions in all Asian subgroups were lower than in NHW. Smoking (current or former) was most prevalent in Korean men (56.6%). Alcohol use was much higher in NHW men (39.9%) and Korean men (36.5%). Vietnamese men had lower proportions of screening tests (52.2%) than other Asian groups. Korean women had lower proportions of screening tests (56.7%) than other Asian groups.

Table 3. Prevalence of risk factors, screening behaviours, and health care access among Asian American ethnic groups versus NHW in California[a], stratified by gender

	Chinese	Japanese	Korean	Filipino	Vietnamese	NHW
Male						
Smoking status						
Current	8.2%	10.1%	21.5%	18.6%	30.5%	15.9%
Former	15.6%	27.5%	35.1%	22.0%	19.4%	32.9%
Never^	76.3%	62.3%	43.4%	59.4%	50.1%	51.2%
Alcohol						
Drinker	19.7%	12.3%	35.5%	34.8%	22.5%	39.9%
None in 1 year	80.3%	87.7%	64.50	65.2%	77.5%	60.1%
BMI						
<25	70.9%	52.4%	58.9%	49.9%	75.1%	40.2%
$\geqslant 25$	29.1%	47.6%	41.1%	50.1%	24.9%	59.8%
Level of physical activity[a]						
No	18.1%	12.5%	15.6%	14.0%	23.7%	11.3%
Some	52.7%	48.5%	53.4%	48.1%	54.5%	46.8%
Moderate	15.1%	17.7%	12.3%	13.2%	11.2%	19.1%
Vigorous	14.2%	21.3%	18.6%	24.7%	18.0%	22.9%
Ever had sigmoidoscopy, colonoscopy, or FOBT[a]						
Never had one of them	18.7%	21.8%	27.6%	31.3%	47.8%	16.5%
Have had one of them	81.3%	78.2%	72.4%	68.7%	52.2%	83.5%
Type of most recent CRC screening						
Colonoscopy	66.2%	55.3%	66.4%	45.5%	49.7%	56.4%
Sigmoidoscopy	11.1%	4.9%	—	11.5%	4.7%	10.8%
FOBT	22.7%	39.8%	31.3%	43.0%	45.6%	32.8%
CRC screening compliance at time of recommendation						
Not compliant	25.7%	34.6%	31.3%	43.5%	50.0%	26.6%
Compliant	74.3%	65.4%	68.7%	56.5%	50.0%	73.4%
Health insurance						
Currently insured	90.3%	93.5%	70.1%	82.9%	90.2%	91.4%
Not	9.7%	6.5%	29.9%	17.1%	9.8%	8.6%
Ever diagnosed with diabetes						
Yes	7.1%	12.5%	7.3%	16.1%	4.1%	7.1%
No	92.9%	87.5%	92.7%	83.9%	95.9%	92.9%
Female						
Smoking status						
Current	2.9%	6.9%	9.5%	4.6%	2.0%	12.4%
Former	5.3%	18.3%	8.6%	9.2%	1.0%	27.4%
Never^	91.9%	74.8%	81.9%	86.3%	97.0%	60.2%
Alcohol						
Drinker	5.9%	9.0%	17.6%	16.9%	14.8%	25.7%
None in 1 year	94.1%	91.0%	82.4%	83.1%	85.2%	74.3%

Table 3. (Continued)

	Chinese	Japanese	Korean	Filipino	Vietnamese	NHW
Level of physical activity[a]						
No	23.6%	22.2%	25.6%	13.8%	12.6%	12.2%
Some	53.5%	43.5%	49.0%	53.1%	53.3%	56.5%
Moderate	18.5%	19.8%	18.7%	17.2%	20.1%	18.6%
Vigorous	4.4%	14.5%	6.7%	15.9%	14.0%	12.7%
BMI						
<25	84.3%	71.2%	83.9%	70.2%	84.7%	58.4%
$\geqslant 25$	15.7%	28.8%	16.1%	29.8%	15.3%	41.6%
Ever had sigmoidoscopy, colonoscopy, or FOBT[a]						
Never had one of them	39.6%	21.4%	43.3%	19.8%	39.4%	18.5%
Have had one of them	60.4%	78.6%	56.7%	80.2%	60.6%	81.5%
Type of most recent CRC screening						
Colonoscopy	44.9%	47.6%	64.1%	39.6%	44.5%	56.5%
Sigmoidoscopy	15.1%	8.1%	6.9%	15.2%	25.2%	8.3%
FOBT	40.0%	44.3%	28.9%	45.2%	30.3%	35.2%
CRC screening compliance at time of recommendation						
Not compliant	36.7%	24.3%	44.6%	35.6%	25.7%	29.4%
Compliant	63.3%	75.7%	55.4%	64.4%	74.3%	70.6%
Health insurance						
Currently insured	90.9%	99.0%	77.2%	97.2%	84.2%	93.2%
Not	9.1%	1.0%	22.8%	2.8%	15.8%	6.8%
Ever diagnosed with diabetes						
Yes	6.8%	8.2%	6.4%	10.2%	3.0%	5.5%
No	93.2%	91.8%	93.6%	89.8%	97.0%	94.5%

Abbreviations: BMI = body mass index; CRC = colorectal cancer; FOBT = faecal occult blood testing; NHW = non-Hispanic white.
^Never smoked (or smoked less than 100 cigarettes).
— Indicate that the estimate is less than 500 people.
[a]Information in this table was obtained from the 2009 California Health Interview Survey.

Survival. Overall, Asian had better DSS than did NHW (Hazard ratio (HR) 0.95, $P = 0.001$). Most Asian subgroups (Indian/Pakistani, HR 0.68, $P < 0.0001$, Chinese, HR 0.94, $P = 0.025$, and Japanese HR 0.93, $P = 0.006$,), except Hawaiian (HR 1.2, $P < 0.0001$), had better DSS than did NHW patients. Table 4 shows the association between disease stage, tumour grade, sex, primary site of tumour, status of surgery, year of diagnosis, age at diagnosis, and median household income with DSS in each ethnicity group. Patients with distal sigmoid colon cancer had better DSS in Filipino (HR 0.8, $P = 0.03$). Advance tumour stages were highly associated with worse DSS in each ethnicity group. High tumour grades were associated with worse DSS in NHW, Filipino and Chinese. Older age at diagnosis was associated with worse DSS in most ethnicity groups except Hawaiian and Vietnamese. Higher income was associated with better DSS only in NHW and Hawaiian.

DISCUSSION

This study is one of the most comprehensive population-based analyses of CRC by ethnicity reported in the literature, and looked at not only clinicopathologic factors (with 359 374 cases included) and also the lifestyle and screening data. Many of our findings confirm previous less comprehensive studies including: Asian groups' lower use of screening (Fenton *et al*, 2009); Asian patients presented with more advanced disease than NHW (Ayanian, 2010; Robbins *et al*, 2012); a younger average age at diagnosis in Asian patients (Koo *et al*, 2008; Norwood *et al*, 2009; Sammour *et al*, 2010).

Racial/ethnic disparities in CRC survival has been extensively documented in the scientific literature (Chien *et al*, 2005; Fenton *et al*, 2009; Robbins *et al*, 2012). We found that most Asian patients had better DSS than did NHW. Differences in tumour site distribution and genetics may explain the high survival rates observed among Asians. That is, relative to other groups, Asians have higher rates of distal colon cancer, which is associated with a decreased risk of mortality. This further confirms the findings of previous studies (Le *et al*, 2009). We also found that Indian/Pakistani patients had better DSS than did other groups even after adjusted by age, tumour stage, grade, and tumour site. According to US census data, Asian Indians are the wealthiest major ethnic group in the country (Goggins and Wong, 2009). Thus, it is reasonable to hypothesise that the relatively higher CRC survival for Indian/Pakistani patients results from better treatment.

Table 4. Multivariate Cox proportional hazards analysis of clinicopathologic variables associated with disease-specific survival in patients with colorectal cancer in each ethnic group

	NHW		Asian		Filipino		Japanese		Chinese		Hawaiian		Korean		Indian/ Pakistani		Vietnamese	
Variable	**HR**	***P*-value**	**HR**	***P*-value**	**HR**	***P*-value**	**HR**	***P*-value**	**HR**	***P*-value**	**HR**	***P*-value**	**HR**	***P*-value**	**HR**	***P*-value**	**HR**	***P*-value**
Stage																		
I	Referent																	
II	2.1	<0.001	2.1	<0.001	2.5	<0.001	2.0	<0.001	2.0	<0.001	2.1	0.001	1.9	0.003	2.5	0.06	2.4	0.003
III	4.7	<0.001	4.8	<0.001	5.1	<0.001	4.8	<0.001	4.2	<0.001	5.2	<0.001	4.0	<0.001	6.3	<0.001	6.5	<0.001
IV	17.3	<0.001	19.5	<0.001	18.3	<0.001	22.2	<0.001	18.8	<0.001	15.6	<0.001	16.3	<0.001	25.6	<0.001	19.9	<0.001
Tumour grade																		
Grade I	Referent																	
Grade II	1.1	<0.001	1.2	0.005		NS		NS		NS	1.7	0.02	1.7	0.04		NS		NS
Grade III	1.3	<0.001	1.5	<0.001	1.5	0.007		NS	1.6	0.002		NS		NS		NS		NS
Grade IV	1.2	<0.001	1.6	0.02		NS		NS		NS		NS		NS		NS		NS
Male vs female	1.1	<0.001	1.1	0.004		NS	1.1	0.01		NS		NS		NS		NS		NS
Primary site																		
Proximal colon	Referent																	
Sigmoid colon	1.1	<0.001	0.96	0.2	0.8	0.03		NS		NS		NS	1.3	0.04		NS		NS
Rectum	1.3	<0.001	1.2	<0.001		NS	1.2	<0.001		NS		NS		NS		NS		NS
Other	1.1	0.048		NS	0.7	NS		NS		NS		NS		NS		NS		NS
Year of diagnosis																		
1988–1997	Referent																	
1998–2008	0.8	<0.001	0.8	<0.001	0.8	0.003	0.79	<0.001	0.8	<0.001	0.7	<0.001	0.7	0.008		NS		NS
Primary surgery performed vs not performed	0.7	<0.001	0.6	<0.001	0.6	0	0.63	<0.001	0.6	<0.001		NS	0.5	0.001		NS		NS
Median household income (in 10 $)	0.99998	<0.001	0.99996	0.01		NS		NS		NS	0.9998	0.002		NS		NS		NS
Age at diagnosis (year)	1.01	<0.001	1.01	<0.001	1.005	0.04	1.009	<0.001	1.01	<0.001		NS	1.02	<0.001	1.03	0.001		NS

Abbreviations: HR = hazard ratio; NHW = non-Hispanic white; NS = not significant.

Lifestyle differences may also explain some of differences in CRC survival. Obese individuals have higher morbidity and mortality for many cancers including CRC (Cress *et al*, 2006). Obese patients have a 50% increased risk of developing CRC and a 30% higher risk of dying from CRC than non-obese patients (Calle *et al*, 2003). Moreover, obese patients treated for CRC have poorer OS than normal-weight patients (White *et al*, 2010). According to our study, overweight and obesity proportions in Asian subgroups were much lower than in NHW. This might be another contributing factor to better survival in Asian groups.

Regarding aetiologic factors, high alcohol intake has been consistently associated with increased risk and moderate or high physical activity with decreased risk of CRC, and these factors vary by race, sex, and socioeconomic status (Murphy *et al*, 2011). Smoking also appears to be a strong risk factor for CRC. In our study, alcohol use was most prevalent in NHW men and Korean men and smoking was most prevalent in Korean men. In contrast to the decreasing trends in CRC incidence reported among all major racial/ethnic groups, CRC rates are actually increasing among some Asian subgroups, including the Korean population (Giddings *et al*, 2012). Relatively high alcohol consumption and high smoking proportions in the Korean community might be related to the significant increase in CRC incidence.

Some limitations should be considered in the interpretation of this study. First, this study was limited by its use of national administrative databases. A lack of data on the individual level socioeconomic status and the administration of systemic therapies limited us from evaluating these factors as potential confounders. Second, the lifestyle and screening data were obtained only from California and included only five Asian subgroups, which may not represent the status of entire United States. However, most Asians in SEER are from California registries.

CONCLUSION

Our results, which are based on a large, national population-based sample, show that there are differences in presenting clinicopathologic features between CRC patients of different races/ethnicities of in the United States and that these differences may affect survival.

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