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Colorectal cancer among Koreans living in South Korea versus California: Incidence, mortality and screening rates

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Abstract

Objectives—This study compared trends in colorectal cancer (CRC) incidence and mortality rates among Koreans in South Korea and Korean Americans and non-Hispanic whites in California between 1999 and 2009, and examined CRC screening rates and socio-demographic correlates of CRC screening in the two Korean populations.

Design—Age-standardized CRC incidence and mortality rates of Koreans in South Korea and Korean Americans and non-Hispanic whites in California for the years 1999–2009 were obtained from annual reports of cancer statistics and modeled using joinpoint regression. Using 2009 data from the Korean National Health and Nutrition Examination Survey and the California Health Interview Survey, we estimated and compared CRC screening rates and test modalities. We used multiple logistic regression to examine socio-demographic correlates of completion of CRC screening according to the guidelines among the two Korean populations.

Results—CRC incidence and mortality rates among South Koreans increased during 1999–2009 but more slowly during the late 2000s. In California, CRC incidence increased among Korean American females but decreased among non-Hispanic whites. About 37% of South Koreans and 60% of Korean Americans reported completion of CRC screening according to guidelines in 2009. Among South Koreans, married status, higher income and private health insurance were associated with CRC screening, adjusting for other factors. Among Korean Americans, having health insurance was associated with CRC screening.

Conclusion—Despite almost identical CRC screening guidelines in South Korea and the US and substantially higher screening rates among Korean Americans as compared to South Koreans, disparities remain in both populations with respect to CRC statistics. Thus, efforts to promote primary and secondary prevention of CRC in both Korean populations are critically important in both countries.

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Keywords

colorectal cancer; incidence; mortality; screening; socio-economic disparities; South Korea; Korean Americans; trends

Introduction

Globally, colorectal cancer (CRC) is the second and third most common cancer in women and men, respectively (IARC. 2010). In recent years, CRC incidence and mortality rates have generally increased in economically developing countries while in economically developed countries rates have stabilized or are declining (Center el al. 2009). CRC screening has been demonstrated to reduce both the incidence of and mortality from CRC (Newcomb et al. 1992, Selby et al. 1992, Selby et al. 1993, Hardcastle et al. 1996, Kronburg et al. 2004, Mandel et al., 1999, Mandel et al. 2000, Atkin et al. 2010, Edwards et al. 2010, Segnan et al. 2011, Schoen et al. 2012). Declines in CRC death rates in the US are consistent with a relatively large contribution from screening and a smaller impact of risk factor reductions and improved treatments (Edwards, et a. 2010). Based on the benefits of screening, the US Preventive Services Task Force and the Asia Pacific Working Group on Colorectal Cancer have recommended CRC screening for average-risk persons aged 50 years or older using annual high sensitivity fecal occult blood test (FOBT) or fecal immunochemical test (FIT), flexible sigmoidoscopy every 5 years, or colonoscopy every 10 years (U.S. Preventive Services Task Force 2002, Sung et al. 2008).

In the US, CRC screening was introduced in the 1970s and 1980s, and gradual increases in utilization of screening have continued since the late 1980s, with marked changes in screening methods including the declining use of FOBT and increasing use of endoscopic procedures such as colonoscopy (Seeff et al. 2004, Meissner et al. 2006). Most health insurance includes coverage for routine CRC screening. The history of CRC screening in South Korea is relatively short compared to the US. In 2002, South Korea developed guidelines for CRC screening in average-risk adults, and the government introduced nationwide CRC screening as part of the National Cancer Screening Program (NCSP) in 2004 (Choi et al. 2010). Currently, in Korea, both government-organized and opportunistic CRC screening is available. Free annual FOBT is provided by the government as part of the NCSP for those with an income level below the 50^{th} percentile, and participants with a positive result can undergo additional screening such as colonoscopy and double-contrast barium enema test (DCBE) at low cost. Those with an income level above the 50^{th} percentile can obtain opportunistic screening and have to pay the full cost of screening out of pocket, whether it is FOBT, flexible sigmoidoscopy or colonoscopy (Yoo. 2008). South Koreans with higher levels of income often purchase private health insurance to supplement coverage under the mandatory National Health Insurance System. However, private health insurance generally does not include coverage for CRC screening (Myong et al. 2012).

Despite the evidence suggesting that screening reduces CRC incidence and mortality, participation in CRC screening is low, especially among South Koreans and Korean Americans (Lemon et al. 2001, Maxwell and Crespi, 2009, Choi et al. 2010, Homayoon et

al. 2012). Demographic characteristics, socioeconomic status, access to health care services and acculturation have been found to be associated with utilization of CRC screening in various populations (Ioannou et al. 2003, Wong et al. 2005, Kandula et al. 2006, Choi et al. 2010, Maxwell et al. 2010, Lee et al. 2011, Myong et al. 2012). Although South Koreans and Korean Americans share genetic and cultural characteristics, they may experience differences with respect to lifestyle, environment and access to health care that affect their rates of CRC screening, incidence and mortality. Comparison of the health status of migrants and host country non-migrants provides an opportunity to separate the influences of genetic and environmental factors (McKay et al., 2003). For example, studies have shown that people who migrate from low-risk to high-risk countries generally experience a gradual increase in cancer incidence (Stewart and Kleihues, 2003), and such studies have helped in understanding the relative contributions of genetic and environmental risk factors for cancer. However, relatively little is known about comparative trends in CRC incidence and mortality rates and about the factors related to participation in CRC screening among Koreans in South Korea and the US.

This study analyzed large scale, population-based data with three objectives. The first objective was to compare trends in CRC incidence and mortality rates among Koreans in South Korea and Korean Americans and non-Hispanic whites in California between 1999 and 2009. The second objective was to compare the proportions of Koreans in South Korea and Korean Americans in California that reported receipt of any CRC screening (lifetime CRC screening) and CRC screening according to the guidelines (up-to-date CRC screening). Finally we sought to identify socio-demographic disparities in CRC screening according to the guidelines among Koreans in South Korea and Korean Americans in California. We analyzed data from Korean Americans in California because one third of all Korean Americans live in California (Hoeffel et al 2012) and the California Health Interview Survey is the largest population-based health survey in the United States that is conducted in Korean language and has a large number of Korean American respondents.

Methods

Age-standardized CRC incidence and mortality rates

Age-standardized CRC incidence and mortality rates by gender were obtained from public data sources in South Korea and California. Rates between 1999 and 2009 in South Korea were obtained from annual reports of cancer statistics published by the Korea Cancer Registry and National Cancer Center (Korea Central Cancer Registry 2011), and statistics on cause of death were obtained from Korean Statistical Information Service of Statistics Korea (Korean Statistical Information Service 2012). For Korean Americans and non-Hispanic whites in California, these statistics were obtained from the California Cancer Registry and California Department of Public Health Death Statistical Master files for 1988–2009. These data sources provided age-standardized rates per 100,000 adults. Rates for Korean Americans and non-Hispanic whites in California used the year 2000 US standard population, and rates for Koreans in South Korea used the year 2000 Korean standard population for incidence and year 2005 Korean standard population for mortality. Since raw data with which to standardize all rates to the same population were not available, the results

support comparison of trends across countries but not comparison of absolute rates across countries.

Analyses of participation in CRC screening

1) Data—Population-based survey data from the publicly available 2009 Korean National Health and Nutrition Examination Survey (KNHANES, for South Koreans) and 2009 California Health Interview Survey (CHIS, for Korean Americans) were used for analysis of participation in CRC screening.

The KNHANES is a nationwide, population-based, cross-sectional health survey designed to assess the health and nutritional status of the non-institutionalized civilian population of South Korea, conducted by the Korea Center for Diseases Control and Prevention. After the first KNHANES was performed in 1998, the fourth round of surveys was conducted in 2007–2009. The present study used data obtained in 2009, which was the 3rd year of the ongoing KNHANES IV. The 2009 KNHANES used a stratified multistage cluster probability sampling design. The sampling frame was derived from the 2005 population and housing census. For 2009 KNHANES, 200 sampling units were randomly selected from the 264,186 primary sampling units encompassing the target population in Korea, and 20–23 households were selected from each primary sampling unit to yield 4600 households. The field survey was conducted by specially trained interviewers at mobile centers and in the participants' households. Surveys were completed by 10,533 participants (participation rate 82.8%; Ministry of Health Welfare & Korea Center of Disease Control and Prevention 2010).

The CHIS, a biennial statewide survey conducted in California, is the largest state health survey in the US. The 2009 CHIS employed a multistage sampling design. Within each of 56 geographic strata, random-digit-dial that included telephone numbers assigned to both landline and cellular service was used to sample households; within each household, one adult (age 18 and over) was randomly selected for a telephone interview. Korean and Vietnamese Americans were oversampled to increase the precision of estimates for these groups. Interviews were conducted in English, Spanish, Cantonese, Mandarin, Vietnamese and Korean. The 2009 CHIS interviewed a total of 47,614 adults. We identified respondents as Korean American based on the Asian group definitions (CHIS 2011).

The samples for this study were restricted to individuals aged 50 years and older because the guidelines in each nation recommend that CRC screening begin at age 50. The final sample sizes of South Koreans and Korean Americans in this study were 3,532 and 519, respectively.

2) Variables—All variables were based on self report. The outcome variables were up-to-date CRC screening, defined as participation in CRC screening according to the guidelines of the respondent's country, which were receipt of either FOBT within the past year, flexible sigmoidoscopy within the past 5 years or colonoscopy within the past 10 years; for South Koreans, the guidelines and our definition also included DCBE within the past 5 years (U.S. Preventive Services Task Force 2002, Sung et al. 2008), and life-time screening, defined as

ever receiving an FOBT, sigmoidoscopy or colonoscopy; for South Koreans, DCBE was also included. DCBE was not assessed in CHIS.

Socio-demographic variables included age, gender, marital status, educational attainment, household income and place of residence. Marital status was categorized as living with a partner or not, and educational attainment was classified as less than high school or high school graduate and over. Tertiles of household income were defined based on the income distribution within each entire original sample prior to restriction to age 50 years and older. Place of residence was categorized as urban or rural based on variables provided in the two data sets. For KNHANES, the variable was based on Korean place name conventions that distinguish urban and rural areas. In CHIS, the classifications of the Federal Office of Rural Health Policy were used, whereby counties are classified based on the Office of Management and Budget designations of metropolitan and non-metropolitan areas but certain census tracts within these counties are designated as rural to account for rural areas within large urban counties. English speaking ability was used as a measure of acculturation in Korean Americans. The 3 response categories were “Only English”, “Very well/ well” and “Not well/ not at all”, which we dichotomized as only English/very well/well and not well/not at all.

For the California sample, health insurance, which generally covers the cost of CRC screening, was dichotomized as “yes” and “no”. This dichotomy was not relevant for the South Korean sample because all South Koreans are insured by the Korean National Health Insurance or medical aid programs. Instead, for the KNHANES sample, a dichotomous variable for private health insurance was used; however, such insurance generally does not cover CRC screening.

3) Statistical analysis—Trends in gender-specific CRC incidence and mortality rates were analyzed using joinpoint models (Kim et al. 2000) fit using the Joinpoint Regression Program Version 4.0.1 (January 9, 2013), available at http://surveillance.cancer.gov/joinpoint/. This model allows for changepoints or “joinpoint” in trend data, at which there is a change in rates; it fits the simplest joinpoint model that the data allow as determined using a permutations test and estimates the average annual percent change (AAPC) in rate along each interval between joinpoints.

Other statistical analyses were carried out using SAS statistical software (version 9.2, SAS institute Inc, NC). Survey weights were used in all analyses. Estimated percentages for socio-demographic variables and for lifetime and up-to-date CRC screening, as well as type of test, were obtained using the surveyfreq procedure. Multiple logistic regression was used to estimate the odds ratio (OR) and 95% confidence intervals (CI) for the association between up-to-date CRC screening and socio-demographic variables using the surveylogistic procedure, and repeated for lifetime CRC screening. For all tests of statistical significance, $p<0.05$ was used.

Results

Table 1 provides estimated average annual percent change in age-standardized CRC incidence and mortality among Koreans in South Korea and Korean Americans and non-Hispanic whites in California between 1999 and 2009. The age-standardized rates are presented in Figure 1. The data upon which the figure is based are provided in the appendix.

Among South Koreans, the CRC incidence rate increased in both sexes during 1999–2009, but with a slowing in the rate of increase around 2005–2006 (from AAPC=8.1 to AAPC=4.4 in males; from AAPC=6.4 to AAPC=3.0 in females, all $P<0.05$). CRC mortality rates increased in both sexes during 1999–2003 (through 2004 for females), then leveled off such that there was no significant change in rates in the more recent years (from AAPC=5.7 to AAPC=−0.1 in males; from AAPC=2.9 to AAPC=−1.0 in females; $P<0.05$ only for first AAPC for each gender). Incidence and mortality rates were higher among males than females ($P<0.05$).

Among Korean Americans in California, the CRC incidence rate increased significantly among females during 1999–2009 (AAPC=2.7, $P<0.05$); among males, no significant change in incidence was detected (AAPC=1.8, $P>0.05$). Both sexes had estimated decreases in mortality rates that were not significantly different from no change (AAPC=−1.3 for males, AAPC=−1.2 for females, both $P>0.05$).

Among non-Hispanic whites in California, CRC incidence rates decreased significantly among both sexes (AAPC=−2.5 for males, AAPC=−1.7 for females, both $P<0.05$); CRC mortality rates also decreased significantly (AAPC=−2.5 for males, AAPC=−2.2 for females, both $P<0.05$).

Table 2 presents socio-demographic characteristics of the two study populations, Koreans in South Korea and Korean Americans in California aged 50 or older, based on the 2009 population-based survey data. The Korean American population was older, more likely to be female, more highly educated, more likely to be in the middle income tertile and more likely to live in urban areas than the South Korean population. English proficiency levels were low among the Korean Americans, with 70% speaking English not well or not at all.

Lifetime CRC screening rates were 42.9% among South Koreans and 70.2% among Korean Americans (data not shown). As shown in Figure 2, up-to-date screening rates were 37.1% among South Koreans and 60.4% among Korean Americans. In comparison, 71.8% of non-Hispanic whites residing in California reported up-to-date CRC screening (data not shown). Among South Koreans with up-to-date CRC screening, about half reported receipt of an FOBT (19.6% of the total sample) and half receipt of colonoscopy (19.2%); in contrast, most Korean Americans with up-to-date CRC screening reported receipt of a colonoscopy (50.2% of the total sample), followed by FOBT (18.9%). Among South Koreans with the lowest income level in this study, the most common CRC screening method was FOBT (18%), followed by colonoscopy (13%). Among South Koreans with the highest income level, the most common CRC screening method was colonoscopy (28%), followed by FOBT (21%; data not shown).

Bivariate analyses examining the association between up-to-date CRC screening and socio-demographic variables are presented in Table 3. South Koreans who were male, less than 65 years of age, married, with higher levels of education and income, living in an urban area and with private health insurance were more likely to report up-to-date CRC screening. Among Korean Americans, the only variable that was significantly associated with up-to-date CRC screening was having health insurance. Patterns of association were similar for lifetime screening for both groups (data not shown).

Table 4 shows the results of multiple logistic regression analysis for the outcome of up-to-date CRC screening among South Koreans and Korean Americans. Among South Koreans, married status (OR=1.48, 95% CI=1.18–1.85), 3rd tertile of income (OR=1.34, 95% CI=1.08–1.66) and private health insurance (OR=1.39, 95% CI=1.11–1.75) were associated with up-to-date screening, controlling for other variables. Among Korean Americans, having health insurance was the only statistically significant correlate of up-to-date CRC screening (OR=2.61, 95% CI=1.04–6.55). Analysis using lifetime CRC screening as the outcome yielded similar results (data not shown).

Discussion

Analyses that encompassed an earlier time period (Bates et al., 2010) found that CRC incidence for Korean American men and women increased significantly between 1988 and 2007 (+3.6% per year for men, (+2.4% per year for women). When examining a more recent time period and allowing for APC changepoints, we found that increases in CRC incidence and mortality rates among Korean Americans in California were starting to level off between 1999 and 2009. Our analyses also show improvements among South Koreans in CRC incidence, starting in 2005/2006, and CRC mortality, starting in 2003/2004. However, in both Korean populations, we did not observe the significant decreases in rates that are found among non-Hispanic whites in California in the same time period. Thus, disparities in CRC incidence and mortality remain.

Possible explanations for these disparities among South Koreans and Korean Americans in California are increases in cancer risk factors due to adoption of a more westernized lifestyle, including dietary changes, lack of physical activity and obesity (Wakai et al. 2006, Han et al. 2011), combined with relatively recent adoption of CRC screening and low uptake of screening. Although the US general population is also increasingly adopting an unhealthy lifestyle as evidenced by the obesity epidemic, there has been a decline in CRC incidence and mortality in the US population overall, which has been largely attributed to increased utilization of CRC screening (Edwards et al. 2010). A comparison between the two California samples points to the important influence of CRC screening utilization on CRC incidence among non-Hispanic whites, who have lower CRC incidence rates than Korean Americans despite higher obesity rates (Maxwell et al.2011). Due to a substantial increase in CRC incidence among Korean Americans, their rates exceeded those of non-Hispanic whites by the end of the study period. This trend is similar to the trend in breast cancer incidence among Asian American women, which was traditionally very low but has increased with change in lifestyle among groups with longer duration of residency in the United States (Keegan et al. 2007). It is possible that CRC incidence and mortality rates will

improve in the future as the preventive impacts of increased screening rates become apparent. Nevertheless, our findings underscore the importance of monitoring trends to identify at-risk populations that may require specialized programs to reduce their cancer burden.

Our findings indicate that participation in CRC screening is less than optimal among Korean Americans in California and even more so among Koreas in South Korea. However, compared to a previous analysis of 2005 CHIS data (Maxwell and Crespi 2009), up-to-date screening rates have increased remarkably among Korean Americans (from 29% in 2005 to 60.4% in 2009) and among non-Hispanic whites (from 59% to 71.8%). It has also been reported that the up-to-date screening rate among South Koreans shows an increasing trend (23% in 2005, 37% in 2008) (Choi et al. 2010). These findings may be due to public health or educational policies and/or increased public awareness about CRC screening. It is important to continue efforts to promote and provide CRC screening.

Screening by colonoscopy is recommended by many professional societies and has received media attention as a most sensitive test (US. Preventive Service Task Force 2002). In South Korea as well as the US, colonoscopy is much more costly than FOBT. Since 2004, the Korean government and NCSP have provided free annual FOBT for low-income individuals. Endoscopy is only provided for free to those whose FOBT results are positive. Furthermore, the national health insurance program only reimburses colonoscopy for those with symptoms or colorectal problems, not for routine screening (Yoo 2008). As described above, use of colonoscopy versus FOBT varied with income level among Koreans in South Korea, suggesting that out-of-pocket cost is an important determinant of the type of test received. The increased utilization of colonoscopy versus FOBT among Korean Americans may also be influenced by the type of test recommended by providers and personal preferences.

Our results regarding determinants of CRC screening are consistent with previously published studies indicating disparities in participation in CRC screening based on socioeconomic status (Juon et al. 2004, Halliday et al. 2007, Lee et al. 2010). South Koreans with low income were less likely to participate in screening than individuals with higher income. The data were consistent with lower screening participation among lower income Korean Americans, but did not reach statistical significance. A previous study reported that top two reasons for non-participation in CRC screening among South Koreans were “without any symptoms” and “lack of time” (Han et al. 2012). Based on these findings, one may speculate that barriers to screening such as these may be more prevalent among lower income South Koreans, even though they are eligible for free FOBT from the NCSP. This highlights the need for health education messages that communicate that CRC screening is valuable because it detects the disease at an early stage when there are no symptoms.

Previous studies have suggested that one of the most important barriers to cancer screening for Korean Americans is lack of access to healthcare (Juon et al. 2004). Korean Americans have the lowest proportion of individuals covered by health insurance and the highest proportion with no usual source of healthcare among Asian American/Pacific Islanders (Kagawa-Singer and Pourat 2000). In this study, Korean Americans with health insurance

were more likely to have received up-to-date CRC screening. Similarly, South Koreans with private health insurance and higher income had significantly higher odds of participating the CRC screening despite the existence of a national health insurance system and organized cancer screening programs such as NCSP targeted to lower income individuals. It is important to improve the quality of healthcare and access to healthcare services by expanding health insurance coverage, and factors which are strongly intertwined with socioeconomic status should be considered as barriers (Sambamoorthi and McAlpine 2003, Ross et al. 2006). In addition to cost and access to health care, cultural factors and health beliefs, such as low perceived need for screening in the absence of symptoms, may influence screening utilization.

This study had limitations. First, no causal relationships were tested to support the association between the screening rate and incidence/mortality. Second, we were limited to using each location's age-standardized incidence and mortality rates as provided by public data sources; as a result, rates for Koreans in South Korea and for Korean Americans and non-Hispanic whites in California are standardized to different age distributions and it is inappropriate to directly compare rates across countries. The standard age distribution of South Korea is younger than that of the United States, which leads to lower apparent rates. However, it is valid to compare trends in CRC rates between South Koreans and Korean Americans in California using these data. Third, both KNHANES and CHIS data are based on self-report, which could introduce bias. However, other studies have found that self-reports of CRC screening were reasonably accurate and exhibited no differential bias by ethnicity (Baier et al. 2000, Walsh et al. 2004). Fourth, KNHANES was administered by in-person interview whereas CHIS was administered by telephone. The response quality thus may be different, because of differences in gaining trust and rapport between the interviewees and interviewers (Holbrook et al. 2003). However, a recent study reported that the sensitivity and specificity of self-report measures of cancer screening were not different by survey method (Vernon et al. 2008). Fifth, some questionnaire items in KNHANES and CHIS (e.g. currently insured) were not identical; therefore, direct comparisons of some factors associated with participation for CRC screening between South Koreans and Korean Americans should be done cautiously. Sixth, although one third of all Korean Americans live in California (Hoeffel et al., 2012), these findings may not be representative of all Korean Americans.

Despite these limitations, this study provides important comparative information on rates and trends in CRC–related indices among Korean Americans in California and Koreans in South Korea. Data suggest that efforts to promote primary and secondary prevention of CRC in Korean populations are critically important in both countries.

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Appendix

Age-standardized rates of colorectal cancer incidence and mortality among South Koreans and among Korean Americans and non-Hispanic whites in California, 1999–2009.

South Koreans

Year	Incidence, male	Incidence, female	Mortality, male	Mortality, female
1999	27.0	17.1	14.0	8.4
2000	28.1	17.1	14.0	8.4
2001	30.5	18.6	14.8	8.5
2002	33.7	19.6	16.4	9.0
2003	36.0	21.3	16.7	9.4
2004	38.8	22.2	17.1	9.5
2005	42.0	23.8	16.7	9.5
2006	44.2	24.9	16.7	9.3
2007	46.0	25.3	17.4	9.1
2008	47.5	25.8	16.9	9.2
2009	50.2	26.9	16.5	9.1

Korean American in California

Year	Incidence, male	Incidence, female	Mortality, male	Mortality, female
1999	43.5	30.5	*	12.4
2000	65.2	34.2	17.4	11.6
2001	45.2	32.3	21.7	14.0
2002	64.2	34.6	18.1	12.7
2003	67.1	29.0	20.3	10.7
2004	46.8	42.9	26.1	14.4
2005	64.1	39.1	20.1	11.8
2006	71.1	39.2	24.1	16.0
2007	59.1	38.4	18.6	11.8

Korean American in California

Year	Incidence, male	Incidence, female	Mortality, male	Mortality, female
2008	60.6	39.1	14.6	9.0
2009	65.8	41.4	19.9	11.6

Non-Hispanic whites in California

Year	Incidence, male	Incidence, female	Mortality, male	Mortality, female
1999	62.1	45.3	21.5	15.6
2000	60.7	44.4	21.5	15.6
2001	59.8	43.0	21.8	15.6
2002	57.8	42.2	20.5	15.4
2003	57.3	42.4	21.0	14.7
2004	53.0	39.8	19.9	14.2
2005	52.8	40.0	19.4	13.6
2006	51.9	39.5	18.7	13.2
2007	52.7	39.3	18.5	13.1
2008	50.3	40.2	17.2	13.2
2009	47.8	36.1	17.8	12.8

* Statistic not displayed due to fewer than 15 cases.

Sources: The Korea Central Cancer Registry, and Korean Statistical Information Service (1999–2009), California Cancer Registry and CDPH Center for Health Statistics Death Master files 1988–2009. SEER*Stat Database: Asian Mortality-California (1988–2009). Linear interpolation of 1990 and 2000 Census counts for 1988–2009.

Key Messages

1. Colorectal cancer screening utilization is substantially lower among South Koreans than among Korean Americans in California.
2. Disparities in colorectal cancer incidence and mortality in both populations are probably due to an increase in behavioral risk factors and underutilization of screening.
3. Efforts to promote primary and secondary prevention of colorectal cancer in Korean populations are critically important in both South Korea and California.

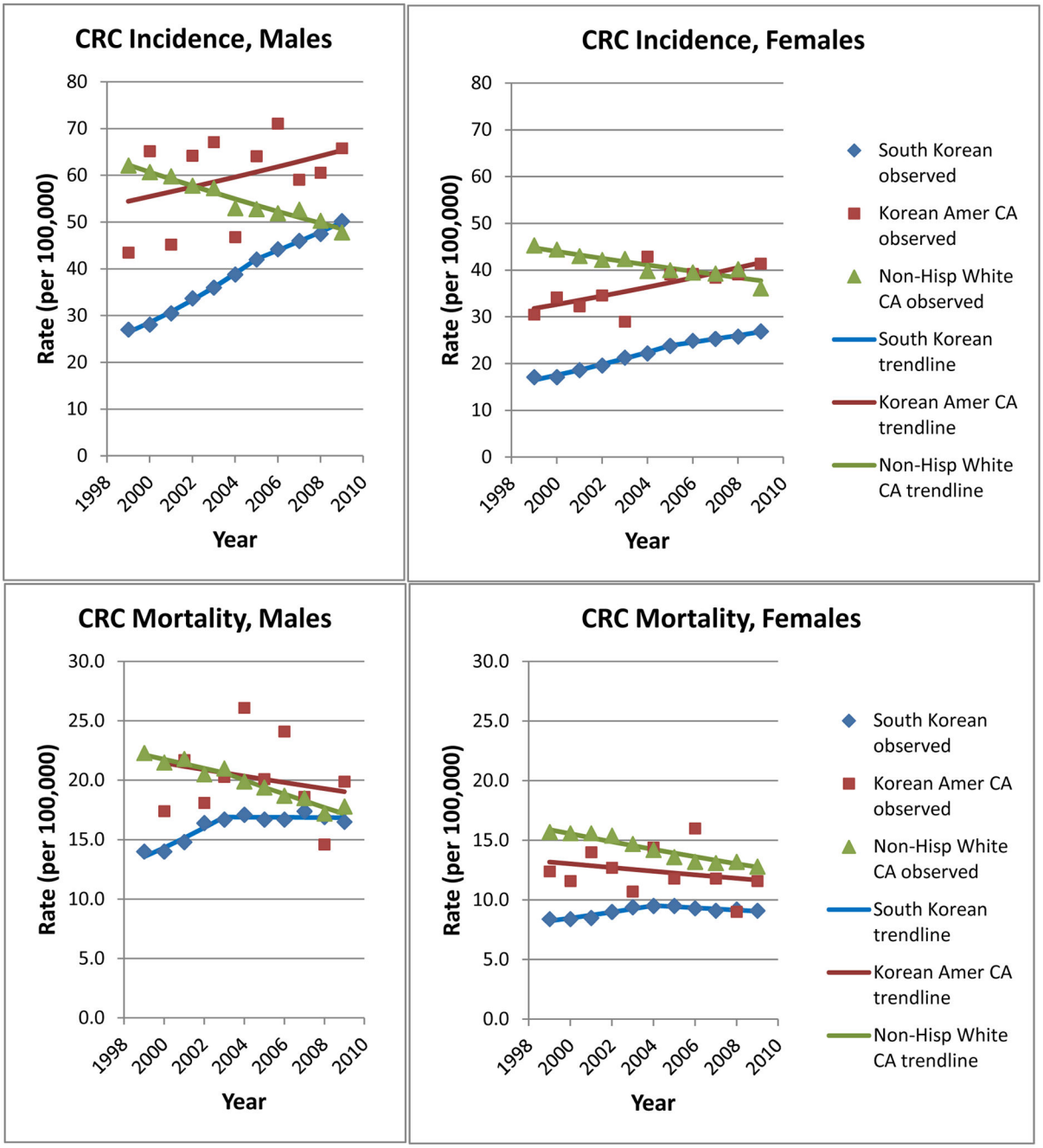

Figure 1.

Trends in age-standardized colorectal cancer incidence and mortality rates among Koreans in South Korea, and Korean Americans and non-Hispanic whites in California. Sources: The Korea Central Cancer Registry, and Korean Statistical Information Service (1999–2009), California Cancer Registry and CDPH Center for Health Statistics Death Master files 1988–2009. SEER*Stat Database: Asian Mortality-California (1988–2009). Trendlines are from joinpoint regression modeling. Note: The South Korea and California data were age-standardized to different age distributions and therefore absolute rates should not be compared across these two populations.

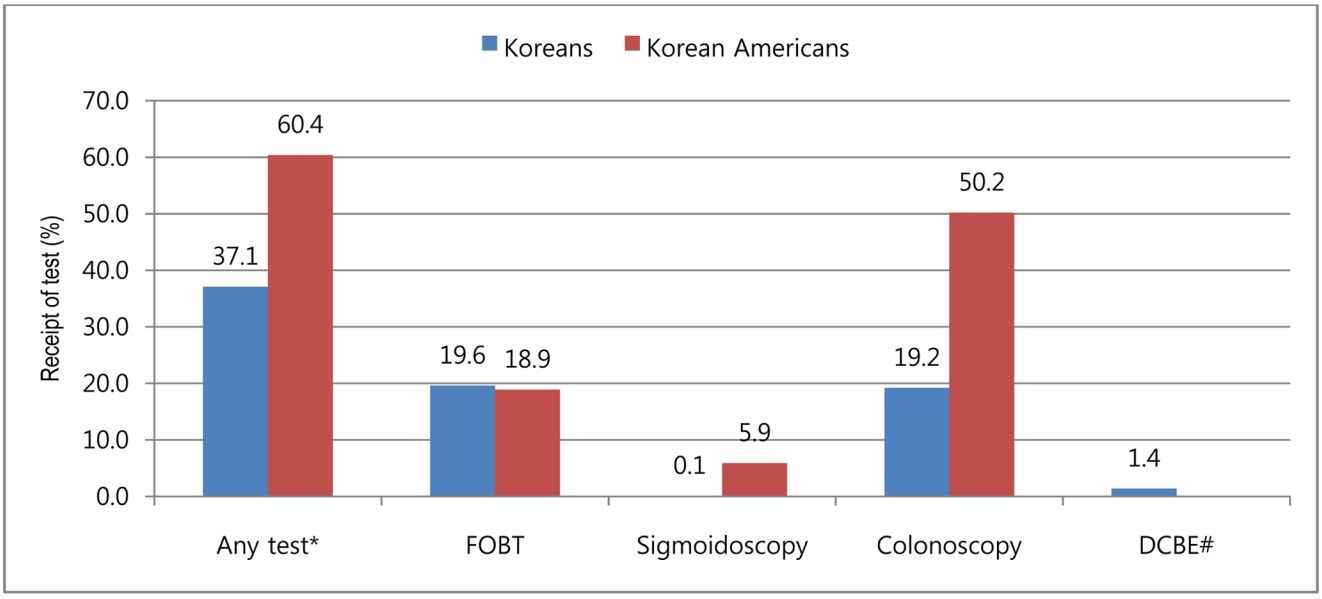

Figure 2.

Up-to-date CRC screening among South Koreans and Korean Americans in California in 2009.

*Any test includes FOBT within the past year, sigmoidoscopy within the past 5 years, and colonoscopy within the past 10 years, and DCBE within the past 5 years (only assessed in the South Korean sample).

DCBE: Double Contrast Barium Enema

Table 1

Estimated average annual percent change in colorectal cancer incidence and mortality by population and gender, 1999–2009

Colorectal cancer incidence			
		Period	**AAPC**
South Koreans	Male	1999–2005	8.1*
		2005–2009	4.4*
Korean Americans in California	Male	1999–2009	1.8
Non-Hispanic Whites in California	Male	1999–2009	−2.5*
South Koreans	Female	1999–2006	6.4*
		2006–2009	3.0*
Korean Americans in California	Female	1999–2009	2.7*
Non-Hispanic Whites in CA	Female	1999–2009	−1.7*

Colorectal cancer mortality			
		Period	**AAPC**
South Koreans	Male	1999–2003	5.7*
		2003–2009	−0.1
Korean Americans in California	Male	1999–2009	−1.3
Non-Hispanic Whites in California	Male	1999–2009	−2.5*
South Koreans	Female	1999–2004	2.9*
		2004–2009	−1.0
Korean Americans in California	Female	1999–2009	−1.2
Non-Hispanic Whites in California	Female	1999–2009	−2.2*

* Indicates p-value < 0.05

Number and location of joinpoints and average annual percent changes (AAPC) were estimated using the Joinpoint Regression Program Version 4.0.1.

Table 2

Socio-demographic characteristics of survey participants aged 50 years and older, 2009 Korean National Health and Nutrition Examination Survey and 2009 California Health Interview Survey

Variables	Koreans in South Korea (N=3532) % (SE[1])	Korean Americans in California (N=519) % (SE[1])
Gender		
Male	46.3 (0.8)	38.0 (4.9)
Female	53.7 (0.8)	62.0 (4.9)
Age		
50–64 years	61.9 (1.2)	48.9 (5.1)
65 years or older	38.1 (1.2)	51.1 (5.1)
Marital status		
Married/living with partner	76.3 (1.1)	78.6 (3.8)
Not married/living with partner	23.7 (1.1)	21.4 (3.8)
Educational attainment		
< High school	67.2 (1.6)	16.7 (3.8)
≥ High school graduate	32.8 (1.6)	83.3 (3.8)
Income level (tertile)[2]		
I	52.8 (1.8)	40.8 (4.2)
II	23.4 (1.1)	37.1 (5.5)
III	27.8 (1.6)	22.1 (4.0)
Place of residence		
Urban	72.3 (3.1)	97.1 (1.2)
Rural	27.7 (3.1)	2.9 (1.2)
Health insurance		
No	-	19.6 (2.7)
Yes	-	80.4 (2.7)
Private health insurance		
No	53.1 (1.3)	-
Yes	46.9 (1.3)	-
English proficiency		
Only/very well/well	-	30.0 (4.1)
Not well/not at all	-	70.0 (4.1)

Estimates obtained using survey weights.

[1] SE: standard error

[2] Income level (tertile) is based on the income distribution within each entire original sample, prior to restrictions on age.

Note: Private health insurance in South Korea generally does not cover CRC screening.

Table 3

Associations between socio-demographic characteristics and up-to-date CRC screening among Koreans in South Korea and Korean Americans in California, 2009 Korean National Health and Nutrition Examination Survey and 2009 California Health Interview Survey

Variables	Koreans in South Korea (N=3532) % (SE[1])			Korean Americans in California (N=519) % (SE[1])		
	Not screened	Screened	p-value	Not screened	Screened	p-value
Gender						
Male	60.5 (1.7)	39.5 (1.7)	0.02	31.3 (6.8)	68.7 (6.8)	0.15
Female	64.9 (1.2)	35.1 (1.2)		44.6 (7.0)	55.4 (7.0)	
Age						
50–64	58.3 (1.3)	41.7 (1.3)	<0.0001	44.5 (7.6)	55.5 (7.6)	0.31
65+	70.4 (1.4)	29.6 (1.4)		34.8 (6.8)	65.2 (6.8)	
Marital status						
Married/living with partner	59.8 (1.3)	40.2 (1.3)	<0.0001	40.0 (7.6)	60.0 (7.6)	0.95
Not married/living with partner	72.9 (1.9)	27.1 (1.9)		39.4 (6.5)	60.6 (6.5)	
Educational attainment						
< High school	66.1 (1.3)	33.9 (1.3)	<0.0001	36.5 (11.9)	63.5 (11.9)	0.77
≥High school graduate	55.5 (2.2)	44.5 (2.2)		40.1 (5.7)	59.8 (5.7)	
Income level (tertile)[2]						
I	68.6 (1.4)	31.4 (1.4)	<0.0001	43.8 (6.7)	56.2 (6.7)	0.69
II	58.7 (2.2)	41.3 (2.2)		38.6 (9.7)	61.4 (9.7)	
III	54.0 (2.1)	45.0 (2.1)		33.1 (10.3)	66.9 (10.3)	
Place of residence						
Urban	60.8 (1.3)	39.1 (1.3)	0.004	38.9 (5.4)	61.1 (5.4)	0.34
Rural	68.2 (2.1)	31.8 (2.1)		60.6 (26.2)	39.4 (26.2)	
Having health insurance						
No	-	-		61.6 (9.8)	38.4 (9.8)	0.007
Yes	-	-		34.2 (5.4)	65.8 (5.4)	
Private health insurance						
No	70.3 (1.5)	29.7 (1.5)	<0.0001	-	-	

Variables	Koreans in South Korea (N=3532) % (SE[1])			Korean Americans in California (N=519) % (SE[1])		
	Not screened	Screened	p-value	Not screened	Screened	p-value
Yes	56.3 (1.5)	43.7 (1.5)		-	-	
English proficiency						
Only/ very well/ well	-	-		31.6 (8.1)	68.4 (8.1)	0.26
Not well/ not at all	-	-		43.0 (6.4)	57.0 (6.4)	

Estimates obtained using survey weights.

[1]SE: standard error

[2]Income level (tertile) is based on the income distribution within each entire original sample, prior to restrictions on age.

Note: Private health insurance in South Korea generally does not cover CRC screening

Table 4

Correlates of up-to-date CRC screening among South Koreans and Korean Americans in California (multiple logistic regression analysis); 2009 Korean National Health and Nutrition Examination Survey and 2009 California Health Interview Survey

Variables	South Koreans	Korean Americans in California
	Adjusted OR[1] (95% CI)	Adjusted OR[1] (95% CI)
Gender (reference: male)		
Female	0.99 (0.83–1.18)	0.73 (0.26–2.04)
Age (reference: 50–64 years)		
65 years or older	0.91 (0.74–1.12)	1.05 (0.28–3.95)
Marital status (reference: not married/living with partner)		
Married/living with partner	1.48 (1.18–1.85)	1.03 (0.36–2.94)
Educational attainment (reference: <high)		
≥ High school	1.16 (0.92–1.47)	0.87 (0.21–3.69)
Income level (tertile) (reference: I)		
II	1.22 (0.97–1.52)	1.26 (0.32–5.01)
III	1.34 (1.08–1.66)	1.21 (0.33–4.44)
Place of residence (reference: rural)		
Urban	1.21 (0.96–1.51)	3.05 (0.15–62.10)
Having health insurance (reference: no)		
Yes	-	2.61 (1.04–6.55)
Private health insurance (reference: no)		
Yes	1.39 (1.11–1.75)	-
English proficiency (reference: well)		
Not well/ not at all	-	0.74 (0.26–2.09)

Estimates obtained using survey weights.

[1] All ORs (odds ratios) are adjusted for gender, age, marital status, educational attainment, income level and urban versus rural place of residence. ORs for South Korean are additionally adjusted for private health insurance status. ORs for Korean American are additionally adjusted for health insurance status and English proficiency. Note: Private health insurance in South Korea generally does not cover CRC screening. Computations conducted using the sample weights provided for each sample.

[2] Income tertiles are based on the income distribution within each entire original sample, prior to restrictions on age.