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# Disparities in Hepatocellular Carcinoma Incidence in California: An Update

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## Abstract

**Background:** Given changes in hepatocellular carcinoma (HCC) incidence and the ethno-demographic landscape, we analyzed recent HCC incidence patterns and trends in California.

**Methods:** Using 47,992 primary, invasive HCC cases diagnosed 1988–2014 from the California Cancer Registry, we calculated age-adjusted incidence rates (IRs), annual percent change (APC), and 95% confidence intervals (CIs), by sex, race/ethnicity, and nativity among Hispanics and Asian ethnic groups.

**Results:** Compared to non-Hispanic Whites (NHWs), all other racial/ethnic groups had higher HCC incidence. Vietnamese had the highest IRs (males: 47.4, 95% CI = 45.3 to 49.5, females: 14.1, 95% CI = 13.0 to 15.3). Foreign-born Chinese, Japanese, Korean, and Vietnamese had higher incidence than U.S.-born. The reverse was observed for Hispanic males while no differences by nativity was seen for Hispanic females. IRs increased most for NHWs. Among Asians, male and

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female Filipinos and Japanese males experienced rate increases, while male and female Koreans and Chinese males experienced rate decreases. U.S.-born male and female Hispanics and Japanese had higher APCs than foreign-born, as did Filipino males, while Chinese males had a reverse pattern. Annual increases in HCC incidence slowed down in recent years for U.S.-born Hispanic males and females and stabilized among male NHWs and non-Hispanic Blacks. For some Asian groups, early time periods exhibited increasing/stable APCs while later time periods showed decreasing APCs.

**Conclusions:** We found significant racial/ethnic and nativity differences in HCC IRs and trends.

**Impact:** With changing trends, closer surveillance of HCC incidence by disaggregated race/ethnicity and nativity is warranted among Hispanics and Asians.

## Introduction

In the United States (U.S.), hepatocellular carcinoma (HCC) incidence is disproportionally higher among men than women and higher for Hispanics and Asian American, Native Hawaiian, and Pacific Islanders (AANHPIs) than non-Hispanic Whites (NHWs) (1). The average annual incidence rate (IR) of HCC in the U.S. from 2000–2014 was 8.0 per 100,000, and was more than three-fold higher in males than females and more than two-fold higher for Hispanics and AANHPIs than for NHWs (2), although there was significant heterogeneity across AANHPI populations. IRs were highest among Vietnamese and lowest among South Asians (3). National reports showed increasing HCC incidence trends for 2003–2011 among NHWs, non-Hispanic Blacks (NHBs) and Hispanics and decreasing trends for AANHPIs (4). However, the stable or decreasing trends among AANHPIs considered as an aggregate group conceal underlying disparities, with some groups showing large increases in rates (3, 5).

California is an ethnically diverse state that is home to a large proportion of the nation's Hispanic and AANHPI residents (6). Between 1988 and 2012, AANHPIs in California had the highest HCC IRs (males 20.6, females 6.7), followed by Hispanics (males 12.9, females 4.2), while NHWs experienced significantly lower rates (males 5.7, females 1.5) (7). Assuming current incidence trends, by 2030, HCC IRs have been forecasted to be lowest among AANHPIs (males 25.1, females 6.9) and highest for NHBs (males 42.8, females 14.9) and Hispanics (males 40.3, females 14.4) (8). Prior reports of HCC incidence in California have also illuminated disparities across Hispanic and AANHPI groups, documenting high incidence associated with foreign-born status, with consistent patterns for males and females (9, 10).

Given the dynamic patterns of HCC incidence and the changing ethno-demographic landscape both in California and the nation as a whole, we seek to update prior HCC incidence reports in California (7, 9), focusing again on state-wide racial/ethnic disparities, but using a larger sample size with data for a wider, more recent time range (1988–2014) for all major races/ethnicities, including detailed Asian ethnic groups. In addition to updated years of registry data, is the contribution of assessing HCC incidence by nativity (U.S.-born and foreign-born) for Hispanics and Asians.

## Materials and Methods

### Study Population

The fundamentals of the study population, data extraction, and analysis have been reported in detail before (9). Briefly, we obtained data for all primary, invasive HCC (International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3) site code 22.0, histology codes 8170–8175) from January 1, 1988, through December 31, 2014 from the California Cancer Registry (CCR), which comprises three of the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program registries (seer.cancer.gov/about).

The analysis included 47,992 total HCC cases: 35,795 males and 12,197 females. AANHPI cases were further categorized into ethnic groups: Chinese, Vietnamese, Filipino, Korean, Japanese and South Asians (countries from the Indian subcontinent). For other AANHPI ethnic groups (e.g. Thai, Hmong, Cambodian, Laotian, Native Hawaiian, Pacific Islander), case counts were too small and/or annual population (denominator) data were not available, and therefore these groups were not reported separately, as combining such heterogeneous ethnic groups would mask disparities. These groups are included in estimates for overall total in the current analysis. Hispanics were not further disaggregated due to a high proportion of cases with ethnicity not specified, although California Hispanics are largely of Mexican origin (11). Hispanic ethnicity and specific AANHPI groups were categorized using methods and algorithms described previously (9, 12, 13).

### Nativity

Registry data on birthplace were available for the majority of Hispanic and Asian cases but for approximately 7% of patients with unknown birthplace, we estimated nativity through statistical imputation using patient's social security number (SSN) and year of issuance as described in detail elsewhere (9, 14). For less than 1% of cases with missing or invalid SSNs, we assigned a nativity based on the known distribution of nativity within similar strata by race/ethnicity, sex, and age in the overall CCR patient population (9).

### Statistical Analysis

We used SEER*Stat software (15) to compute age-adjusted IRs (per 100,000 population; standardized to the 2000 U.S. standard million population) by sex and race/ethnicity for three periods 1988–2004, 2005–2014, and 1988–2014. We used the time periods 1988–2004 and 2005–2014 so as to better compare and contrast our findings with previous findings of liver cancer in California by nativity from 1988 to 2004 in the paper by Chang et al. (9). 95% confidence intervals (CI) were calculated using Tiwari et al., 2006 modification (16). Annual population counts for incidence calculations were estimated using linear interpolation and extrapolation of 1990, 2000, and 2010 Census counts. For nativity population estimates, we used Integrated Public-Use Microdata from Census Summary File for 1988–2004 and the American Community Survey for 2005–2014 using smoothing with a spline-based function as described in detail elsewhere (9, 14). To analyze temporal trends of incidence rates, we calculated APC estimates using weighed least squares method and joinpoint regression models (17). We also conducted trend analysis on 3-year average age-

adjusted IRs to improve rate stability for groups with <5 yearly case counts. All statistical tests were 2-sided with $P < 0.05$ indicating statistical significance.

## Results

For almost every racial/ethnic group, nearly three-quarters of cases were male and one-quarter were female (Supplementary Table S1). Among Hispanics, there was a higher proportion of U.S.-born cases than foreign-born cases (Supplementary Table S2). Except for Japanese, more than 90% of Asian cases were foreign-born. Among Hispanics and Asian ethnic groups, stage distributions were similar between U.S. and foreign-born, with the striking exception of Vietnamese, where U.S.-born had more localized tumors than foreign-born, even though the proportion of cases diagnosed with distant stage were equivalent. However, there were also more foreign-born than U.S.-born Vietnamese with “unspecified” stage (12.4% vs. 4.0%).

### HCC incidence by race/ethnicity and sex

Regardless of time period, all racial/ethnic groups had higher HCC rates than NHW, except Japanese males and South Asian males during the period 2005–2014 (Table 1). During 1988–2014, overall HCC IRs were highest for Vietnamese males (IR = 47.4, 95% CI = 45.3–49.5), followed by Korean males (IR = 25.9, 95% CI = 24.2–27.6) and Chinese males (IR = 20.7, 95% CI = 20.0–21.5). Vietnamese females had the highest HCC IR of all other female racial/ethnic groups for all time periods (Table 2).

### HCC incidence by nativity, race/ethnicity, and sex

Among males, foreign-born Chinese, Japanese, Korean, and Vietnamese had higher HCC incidence than U.S.-born, while the reverse was seen for Hispanics and South Asians (Table 1). No appreciable difference by nativity was seen among Filipino males. Foreign-born Vietnamese males had the highest HCC incidence with IRs of 51.1 (95% CI = 47.4–55.1) for 1988–2004, 46.0 (95% CI = 43.4–49.0) for 2005–2014, and 47.7 (95% CI = 45.6–50.0) for the full time period of 1988–2014. Similar patterns by nativity were seen among Asian females (Table 2), although for some groups, the number of U.S.-born cases was limited. For Hispanic females, HCC IRs did not vary by nativity.

### Annual percent change in HCC incidence by race/ethnicity and sex

For 1988–2014, HCC IRs increased most for NHW males compared to males of other racial /ethnic groups (APC = 4.9%; Table 3 and Figure 1A). The next highest increase among males was for NHBs, and Hispanics (APCs = 3.9% for both). Among Asian groups, Japanese and Filipino males experienced increasing trends (APC = 1.9% and 1.1%, respectively), while Chinese and Korean males experienced decreasing trends (APC = −1.5% and −1.2%, respectively). Rate increases among South Asian males and decreases among Vietnamese males were not statistically significant. Similar patterns in APCs were seen among females (Table 4 and Figure 1B).

Using joinpoint regression trend models with one joinpoint over the study time period, among males, we found changing trends in APCs for most groups (Table 3). For NHW and

NHB males, HCC incidence increased annually in earlier years (5.6% and 5.5%, respectively) then stabilized in recent years (1.6% and −0.1%, respectively). Among females, APCs did not change for NHWs and NHBs (Table 4). For most Asian groups, regardless of sex, there was a pattern of annual increase then decrease for early vs. recent time periods.

### Annual percent change in HCC incidence by nativity, race/ethnicity, and sex

U.S.-born male and female Hispanics and Japanese had higher APCs than foreign-born (Table 3 and Table 4). A similar pattern was seen for Filipino males. Among Chinese males, HCC incidence decreased more strongly for U.S.-born than foreign-born. Using joinpoint models, a slowing down of the increase in rates was observed for U.S.-born Hispanic males (1988–2000 APC = 9.0% and 2000–2014 APC = 3.8%). Changing trends were not observed among foreign-born Hispanic males (1988–2014 APC: males = 3.0%). Among Asian males, greater decreasing trends were experienced by foreign-born Chinese (1988–2009 APC = −0.6%, $P>0.05$ and 2009–2014 APC = −7.1%, $P<0.05$) than U.S.-born Chinese (1988–2014 APC = −2.1%, $P<0.05$) and U.S.-born Japanese (1988–2009 APC = 5.2%, $P<0.05$ and 2009–2014 APC = −12.9%, $P>0.05$) compared to foreign-born Japanese (1988–2014 APC = −0.9%, $P>0.05$). Among females, APCs did not change for foreign-born Hispanics, however for U.S.-born Hispanics the pattern was similar to that for males. Table 5 provides a summary of these findings.

## Discussion

We report here on updated HCC IRs and trends by sex, detailed race/ethnicity, and nativity in California, between 1988 and 2014. We disaggregated Asians into six groups, and compared IRs among Hispanics and Asians by nativity (U.S.-born vs. foreign-born). We found evidence of recent slowing down in the incidence increases for NHW males, NHB males and U.S.-born Hispanic males and females, while we observed decreases for some male and female Asian ethnic groups. Over the 27-year period, trends of increasing incidence were seen for female and male NHWs, NHBs, Hispanics, and for Japanese and Filipino males, while trends of decreasing incidence were seen for female and male Koreans and Chinese males. U.S.-born Hispanics had a larger increase in HCC IRs compared to foreign-born, regardless of sex. A similar pattern for nativity was observed for Japanese and Filipino males. However, among Chinese males, U.S.-born experienced a larger decline in HCC incidence than foreign-born. Despite recent declines in incidence trends, rates of HCC remained high among Asian ethnic groups. Among both males and females, Vietnamese had the highest and NHWs had the lowest HCC IRs compared to all other racial/ethnic groups. These findings were consistent over three time periods: early (1988–2004), late (2005–2014), and total (1988–2014). Among Hispanics and South Asians, U.S.-born had higher HCC IRs than foreign-born but for all other Asian groups, foreign-born had higher IRs than U.S.-born.

Since 2000, national HCC IRs have increased for most racial/ethnic groups, with the highest increase for NHW males (APC 4.6%), which is similar to what we found in California (APC 4.9%). National statistics that show stable or decreasing trends among AANHPI considered

as an aggregate group conceal underlying disparities, due likely to differences in ancestry, lifestyle and socioeconomic factors, and immigration patterns. However, when disaggregated, the ethnic-specific rates reveal increases in HCC incidence among some AANHPI groups (non-Hispanic Pacific Islander males, 3.7% APC; Southeast Asian females, 6.0% APC) (3, 5).

Our findings are similar to a recent report of HCC IRs in California for 1988–2012 by Pham et al., however, we found lower APCs for every racial/ethnic group with more current data for 2013 and 2014 (7), reflecting recent slowing down in incidence trends and continuing declines in some AANHPI groups. For example, the 1988–2012 APC of 4.7% for Hispanic males decreased to 3.9% by 2014. For Korean males, an APC of −0.5% in 2012 became greater (−1.2%) and statistically significant in 2014. We found higher IRs for foreign-born than U.S.-born among most Asian groups, which is in line with a previous California report for 1988–2004 where foreign-born Asians had 5-fold higher rates than U.S.-born (9). U.S.-born Hispanic males in our study had two-fold higher IRs than foreign-born Hispanic males, which is in agreement with 1993–2013 incidence estimates from the Multiethnic Cohort of almost 37,000 Hispanics living in California and Hawaii (18).

Recent incremental changes in the prevention and management of HBV and HCV may have helped and may continue to help attenuate HCC IRs and APCs both nationally and in California. For example, HBV outreach programs in Asian communities have played a significant role in increasing awareness, screening, and treatment of HBV in California (19). The implementation of these programs could explain the decline in HCC IRs among the Chinese population. Improvements in HCV treatment and gaps in previous risk-based screening guidelines have also helped formulate new guidelines for HCV screening, most notably to include asymptomatic people in the 1945–1965 birth cohort among whom nearly three-fourths of all HCV infections occur (20, 21). It is unclear if the consequences to these changes are detectable in our analysis, but it is worth noting. Furthermore, routine HBV vaccination for adults with diabetes starting in 2012 (22), expanded guidelines for HBV screening in 2014 with a focus on foreign-born NHB and AANHPI groups (23), and subsequent Medicare & Medicaid reimbursement for HBV screening and vaccinations (24) may further reduce HCC incidence in the future.

Regardless of the potential impact of prevention efforts, surveillance of HCC incidence is important and warranted, especially in California, where HCC incidence is forecasted to increase for NHWs, NHBs, and Hispanics, with NHBs and Hispanics expected to have the highest rates in 2030 (8). Although AANHPI IRs started to decline in 2010 and are projected to be the lowest in 2030, rates among AANHPI remain high and warrant continued prevention efforts. Furthermore, considering the aging baby boomer U.S. birth cohort who have the highest prevalence of HCV infection (25, 26), and the obesity epidemic in the U.S, which disproportionately burdens certain racial/ethnic groups more than others (27), it is expected that HCC incidence will continue to increase nation-wide (26).

Racial/ethnic differences in IRs and APCs are likely due to variations in the relative contributions of HCC risk factors among different racial/ethnic and nativity groups. However, knowledge of attributable risk of HCC risk factors by race/ethnicity and nativity is

lacking and the relative contributions of risk factors among detailed racial/ethnic groups is largely unknown because previous studies have not had sufficient representation of small but growing populations such as Hispanic and AANHPI groups. In the U.S., more than 20% of HCCs are attributable to HCV infection (28, 29), the most frequently reported etiologic factor for Blacks and Hispanics with HCC (30–32). HCV prevalence ranges from 3.0% among NHBs to 1.3% among Mexican Americans (25). HCV prevalence estimates among AANHPIs within large population or cohort studies are not available, but have been reported by community and clinic studies that closely mirror countries of origin (25), ranging from 0.1% in Hong Kong to nearly 6% in Vietnam (33). Approximately 5% of HCCs are attributable to HBV infection (28, 29), the most frequently reported HCC risk factor among Asians, especially foreign-born Asians (30–32). Chronic HBV rates vary among Asians, from 0.6% among Japanese to 13.6% among Laotians and among individuals with chronic HBV, 58% are foreign-born Asians. For other racial/ethnic groups, chronic HBV prevalence ranges from 0.7–0.9% among Mexican-Americans and NHWs to 0.89–0.98% among NHBs and “other” which includes AANHPIs and American Indians/Alaska Natives (34).

The proportion of HCC attributable to alcohol differs by race/ethnicity, ranging from 5% for AANHPIs to 20% for Hispanics (28, 29). Liver vulnerability to alcohol consumption also varies by race/ethnicity, with Blacks showing greater susceptibility to ALD liver damage than NHWs, given the same amount of alcohol intake (35). In addition, there is an interactive effect between alcohol and hepatitis, especially HCV; alcohol shows a supermultiplicative synergy (32, 36, 37). The associations between tobacco smoking and HCC risk is controversial, and may depend on the study population (38). Furthermore, substantial synergy is observed between smoking and HBV/HCV infection, with superadditive interaction with HBV and supermultiplicative interaction with HCV (39). HCC risk with smoking may also be synergistic with alcohol and obesity (40).

In the U.S., one-third of HCC diagnoses are attributable to metabolic disorders (i.e., obesity, diabetes, metabolic syndrome, and NAFLD) (28, 29). Data on interactions between metabolic syndrome and other HCC risk factors are sparse and inconsistent, and may depend on the co-occurrence of cirrhosis (37, 41, 42). Metabolic disorders vary by racial/ethnic groups, as illustrated by differences in the burden of the ongoing overweight and obesity epidemic and diabetes (27, 43). NAFLD, increasingly considered to be the hepatic manifestation of metabolic syndrome, is also increasing (44, 45), with prevalence ranging from 13% among Blacks to 23% among Hispanics (46). Data on AANHPIs in the U.S. (47), as well as studies in Asian countries (48) indicate that NAFLD makes up only a minority of cirrhosis and HCC cases, which could reflect higher endemic viral hepatitis or the relative lack of obesity among these populations (48). Furthermore, NAFLD may manifest differently among Asian populations for which lean-NAFLD, NAFLD in the absence of obesity, has been observed (48–50). However, no studies have been done to assess these patterns among AANHPI populations.

Inherent to limitations in cancer registry data, we did not have data on known HCC risk factors (HBV/HCV infection, alcohol, smoking, body size, and metabolic disorders). Therefore we could not assess how these factors influenced reported HCC IRs for different racial/ethnic groups. Misclassification of nativity data is also a potential concern (9).

However, although false reporting birthplace of undocumented immigrants as U.S.-born would have affected the numerator in our incidence calculations, the denominator would likely also be subject to the same reliability issue from Census and American Community Survey data and, therefore, not present a bias in this analysis. Furthermore, since we are using Census and American Community data on a large scale for our population estimates, we minimize the risks associated with under-counts in the case of the Census or sampling bias in the case of the American Community Survey. The generalizability of our Hispanic population to the rest of the U.S. could also be questioned as a higher proportion of Hispanics in California are from Mexico (11) than nation-wide proportions (51). We were also not able to disaggregate Hispanics due to high proportions of missing Hispanic origin data and we were unable to assess rates by nativity for NHWs and NHBs due to high proportions of unknown birthplace data. Finally, our analysis was limited by the small number of observed HCC cases in some AANHPI groups, limiting the precision and reliability of nativity-stratified analyses.

Nevertheless, our analysis of HCC IRs and trends in a highly populous and ethnically diverse U.S. state is based on high-quality cancer registry data and our population-based design renders our results applicable to the general population. We worked with a large dataset of nearly 47,000 cases, 60% of whom were non-NHWs, and utilized data from a 27-year time-frame. Therefore, we had high statistical power to study IRs by time period, sex, disaggregated Asian ethnicity, and nativity. Furthermore, our nativity data was largely complete, missing only for 7% of Hispanics and AANHPIs.

In summary, we found significant racial/ethnic and nativity differences in HCC IRs and trends. Our data reflects changing demographics in California, an ethnically diverse state, but our findings are relevant to larger nation-wide efforts to reduce the burden of HCC, especially among fast-growing, high-risk populations such as U.S.-born Hispanics and some Asian immigrant groups (6, 9). Further surveillance of HCC incidence by disaggregated race/ethnicity and nativity will help identify specific groups for the prevention of HCC with a special focus on attributable HCC risk factors.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Abbreviations:

| | |
|---|---|
| **APC** | annual percent change |

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|---|---|
| **AANHPI** | Asian American/Native Hawaiian/Pacific Islander |
| **CI** | confidence interval |
| **HBV** | hepatitis B virus |
| **HCV** | hepatitis C virus |
| **IR** | incidence rate per 100,000 persons |
| **NAFLD** | non-alcoholic fatty liver disease |
| **NHB** | non-Hispanic Black |
| **NHW** | non-Hispanic White |
| **U.S.** | United States |

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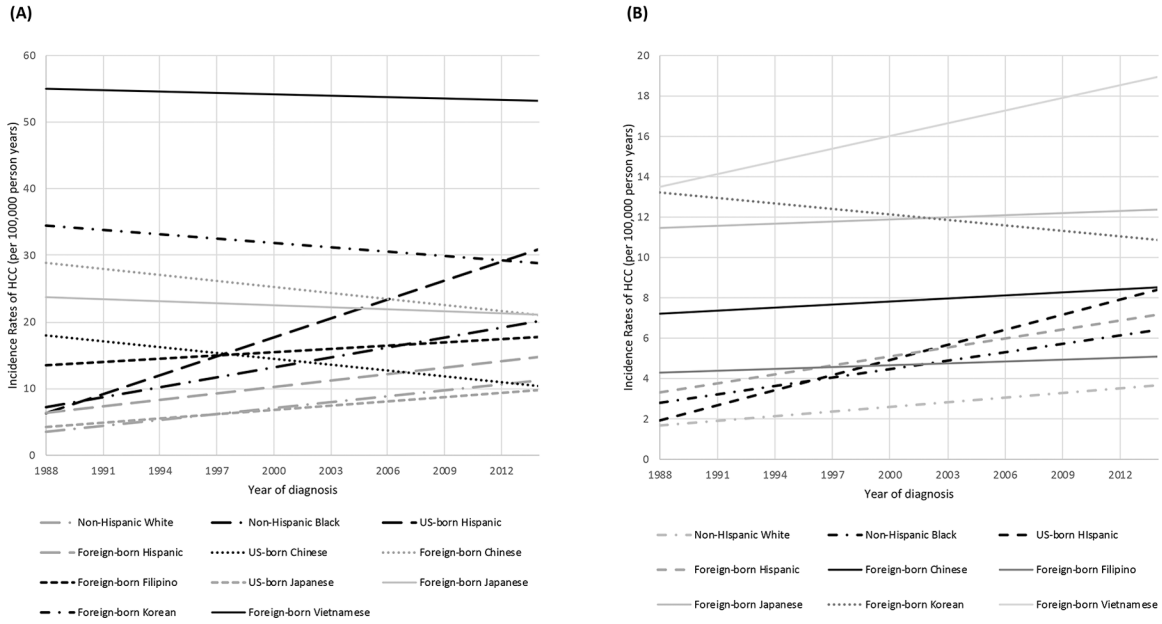


**Figure 1.**

Annual percent change of incidence rates for hepatocellular carcinoma in males (**A**) and females (**B**) by race/ethnicity and nativity in California during 1988–2014. Dashed line indicates a significant statistical linear trend and solid line indicates no significant statistical linear trend. Annual percent change in 1-year HCC incidence rates could not be estimated for U.S.-born Filipino, U.S.-born Korean, U.S.-born Vietnamese, and both U.S.-born and foreign-born South Asian males. Annual percent change in 1-year HCC incidence rates could not be estimated for U.S.-born Chinese, U.S.-born Japanese, U.S.-born Filipina, U.S.-born Korean, U.S.-born Vietnamese, and both U.S.-born and foreign-born South Asian females.

**Table 1:**

Age-Adjusted Incidence Rates (per 100,000) of Hepatocellular Carcinoma in Males, by Race/Ethnicity and Nativity, California, 1988–2004, 2005–2014, 1988–2014

| | 1988–2004 | | | 2005–2014 | | | 1988–2014 | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Case N** | **Population N** | **IR (95% CI)** | **Case N** | **Population N** | **IR (95% CI)** | **Case N** | **Population N** | **IR (95% CI)** |
| All | 14,799 | 272,151,905 | 6.9 (6.8–7.1) | 20,996 | 183,895,837 | 11.8 (11.6–11.9) | 35,795 | 456,047,742 | 9.2 (9.1–9.3) |
| Non-Hispanic White | 6,136 | 139,386,726 | 4.3 (4.2–4.4) | 8,583 | 77,563,290 | 8.1 (7.9–8.3) | 14,719 | 216,950,016 | 5.9 (5.8–6.0) |
| Non-Hispanic Black | 1,160 | 18,738,199 | 9.4 (8.8–10.0) | 1,698 | 11,705,142 | 15.6 (14.8–16.4) | 2,858 | 30,443,341 | 12.3 (11.8–12.8) |
| Hispanic | 3,197 | 85,169,161 | 9.8 (9.4–10.1) | 6,078 | 70,572,613 | 16.0 (15.6–16.5) | 9,275 | 155,741,774 | 13.2 (12.9–13.4) |
| U.S.-born Hispanic | 1,882 | 46,606,450 | 12.8 (12.2–13.4) | 3,479 | 42,489,340 | 24.4 (23.5–25.2) | 5,361 | 89,095,790 | 18.6 (18.1–19.1) |
| Foreign-born Hispanic | 1,315 | 38,562,711 | 7.6 (7.2–8.1) | 2,599 | 28,083,273 | 11.6 (11.1–12.1) | 3,914 | 66,645,984 | 9.8 (9.5–10.2) |
| Chinese | 1,466 | 7,503,043 | 22.6 (21.4–23.8) | 1,297 | 5,906,174 | 18.9 (17.9–20.0) | 2,763 | 13,409,217 | 20.7 (20.0–21.5) |
| U.S.-born Chinese | 119 | 2,490,417 | 13.5 (11.1–16.3) | 94 | 2,015,059 | 10.9 (8.7–13.4) | 213 | 4,505,476 | 12.3 (10.6–14.1) |
| Foreign-born Chinese | 1,347 | 5,012,626 | 23.9 (22.6–25.2) | 1,203 | 3,891,115 | 20.0 (18.9–21.3) | 2,550 | 8,903,741 | 21.9 (21.1–22.9) |
| Filipino | 679 | 6,852,385 | 13.2 (12.2–14.2) | 790 | 5,440,850 | 15.3 (14.2–16.5) | 1,469 | 12,293,235 | 14.3 (13.5–15.0) |
| U.S.-born Filipino | 34 | 2,365,263 | 10.2 (6.5–15.0) | 66 | 1,991,048 | 19.2 (13.6–26.0) | 100 | 4,356,311 | 14.4 (11.1–18.1) |
| Foreign-born Filipino | 645 | 4,487,122 | 13.4 (12.3–14.5) | 724 | 3,449,802 | 15.3 (14.1–16.6) | 1,369 | 7,936,924 | 14.4 (13.6–15.2) |
| Japanese | 202 | 2,588,565 | 7.5 (6.5–8.7) | 180 | 1,230,123 | 8.9 (7.6–10.4) | 382 | 3,818,688 | 8.1 (7.3–9.0) |
| U.S.-born Japanese | 117 | 1,823,921 | 5.6 (4.5–6.7) | 107 | 836,792 | 7.1 (5.8–8.7) | 224 | 2,660,713 | 6.1 (5.3–7.0) |
| Foreign-born Japanese | 85 | 764,644 | 19.6 (15.2–24.8) | 73 | 393,331 | 15.3 (11.7–20.0) | 158 | 1,157,975 | 17.0 (14.2–20.1) |
| Korean | 532 | 2,558,709 | 29.1 (26.4–32.0) | 480 | 2,069,136 | 23.2 (21.1–25.5) | 1,012 | 4,627,845 | 25.9 (24.2–27.6) |
| U.S.-born Korean | 11 | 624,311 | 19.5 (9.7–34.4) | 15 | 587,313 | 15.8 (8.2–26.9) | 26 | 1,211,624 | 18.0 (11.4–26.6) |
| Foreign-born Korean | 521 | 1,934,398 | 29.7 (26.9–32.7) | 465 | 1,481,823 | 23.6 (21.4–26.7) | 986 | 3,416,221 | 26.3 (24.6–28.2) |
| South Asian | 73 | 2,512,780 | 7.0 (5.2–9.1) | 143 | 3,144,798 | 7.6 (6.3–9.1) | 216 | 5,657,578 | 7.4 (6.3–8.6) |
| U.S.-born South Asian | 8 | 637,025 | 20.6 (8.1–41.0) | 6 | 898,725 | 28.0 (4.4–75.9) | 14 | 1,535,750 | 17.6 (8.0–31.8) |
| Foreign-born South Asian | 65 | 1,875,755 | 6.7 (4.9–9.0) | 137 | 2,246,073 | 7.4 (6.1–9.1) | 202 | 4,121,828 | 7.2 (6.1–8.4) |
| Vietnamese | 921 | 3,393,663 | 50.7 (47.0–54.6) | 1,242 | 2,843,813 | 45.6 (43.0–48.3) | 2,163 | 6,237,476 | 47.4 (45.3–49.5) |
| U.S.-born Vietnamese | 10 | 792,157 | 39.8 (13.8–83.1) | 32 | 915,753 | 32.6 (21.2–48.5) | 42 | 1,707,910 | 32.1 (22.3–44.8) |
| Foreign-born Vietnamese | 911 | 2,601,506 | 51.1 (47.4–55.1) | 1,210 | 1,928,060 | 46.0 (43.4–49.0) | 2,121 | 4,529,566 | 47.7 (45.6–50.0) |

Abbreviations: IR, incidence rate.

**Table 2:**

Age-Adjusted Incidence Rates (per 100,000) of Hepatocellular Carcinoma in Females, by Race/Ethnicity and Nativity, California, 1988–2004, 2005–2014, 1988–2014

| | 1988–2004 | | | 2005–2014 | | | 1988–2014 | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Case N** | **Population N** | **IR (95% CI)** | **Case N** | **Population N** | **IR (95% CI)** | **Case N** | **Population N** | **IR (95% CI)** |
| All | 5,433 | 273,037,324 | 2.1 (2.0–2.2) | 6,764 | 185,995,534 | 3.4 (3.3–3.5) | 12,197 | 459,032,858 | 2.7 (2.6–2.7) |
| Non-Hispanic White | 2,175 | 142,615,254 | 1.2 (1.2–1.3) | 2,352 | 78,362,685 | 2.0 (2.0–2.1) | 4,527 | 220,977,939 | 1.6 (1.5–1.6) |
| Non-Hispanic Black | 403 | 19,386,300 | 2.7 (2.4–3.0) | 512 | 12,004,055 | 4.1 (3.8–4.5) | 915 | 31,390,355 | 3.4 (3.1–3.6) |
| Hispanic | 1,227 | 80,015,852 | 3.4 (3.2–3.6) | 2,106 | 68,083,389 | 5.3 (5.0–5.5) | 3,333 | 148,099,241 | 4.4 (4.2–4.5) |
| U.S.-born Hispanic | 530 | 45,755,983 | 3.2 (2.9–3.5) | 900 | 41,752,287 | 5.9 (5.6–6.4) | 1,430 | 87,508,270 | 4.5 (4.3–4.8) |
| Foreign-born Hispanic | 697 | 34,259,869 | 3.5 (3.3–3.8) | 1,206 | 26,331,102 | 5.0 (4.7–5.3) | 1,903 | 60,590,971 | 4.3 (4.1–4.5) |
| Chinese | 449 | 7,985,862 | 6.2 (5.6–6.8) | 476 | 6,573,411 | 6.0 (5.4–6.5) | 925 | 14,559,273 | 6.1 (5.7–6.5) |
| U.S.-born Chinese | 39 | 2,359,603 | 3.9 (2.8–5.4) | 31 | 1,931,719 | 4.2 (2.8–6.1) | 70 | 4,291,322 | 3.9 (3.0–5.0) |
| Foreign-born Chinese | 410 | 5,626,259 | 6.5 (5.9–7.2) | 445 | 4,641,692 | 6.2 (5.6–7.3) | 855 | 10,267,951 | 6.4 (6.0–6.9) |
| Filipino | 231 | 7,809,502 | 3.7 (3.2–4.2) | 308 | 6,386,642 | 4.2 (3.7–4.7) | 539 | 14,196,144 | 4.0 (3.6–4.3) |
| U.S.-born Filipino | 13 | 2,231,765 | 4.8 (2.4–8.3) | 20 | 1,869,157 | 4.5 (2.6–7.0) | 33 | 4,100,922 | 4.6 (3.0–6.5) |
| Foreign-born Filipino | 218 | 5,577,737 | 3.6 (3.2–4.2) | 288 | 4,517,485 | 4.1 (3.6–4.8) | 506 | 10,095,222 | 3.9 (3.6–4.3) |
| Japanese | 296 | 3,066,109 | 6.6 (5.8–7.4) | 193 | 1,582,090 | 6.0 (5.2–7.0) | 489 | 4,648,199 | 6.7 (6.1–7.3) |
| U.S.-born Japanese | 52 | 1,829,367 | 2.1 (1.6–2.8) | 43 | 881,054 | 2.3 (1.6–3.3) | 95 | 2,710,421 | 2.2 (1.8–2.7) |
| Foreign-born Japanese | 244 | 1,236,742 | 13.2 (11.4–15.2) | 150 | 701,036 | 10.2 (8.6–12.5) | 394 | 1,937,778 | 12.8 (11.6–14.3) |
| Korean | 258 | 2,914,486 | 11.2 (9.9–12.8) | 200 | 2,378,746 | 7.9 (6.8–9.1) | 458 | 5,293,232 | 9.5 (8.6–10.4) |
| U.S.-born Korean | 5 | 607,767 | 5.8 (1.8–13.4) | <5 | 553,815 | | 8 | 1,161,582 | 4.4 (1.8–8.4) |
| Foreign-born Korean | 253 | 2,306,719 | 11.5 (10.1–13.2) | 197 | 1,824,931 | 8.1 (7.0–9.6) | 450 | 4,131,650 | 9.7 (8.8–10.7) |
| South Asian | 24 | 2,197,346 | 2.4 (1.5–3.7) | 56 | 2,818,460 | 3.0 (2.3–4.0) | 80 | 5,015,806 | 2.8 (2.2–3.5) |
| U.S.-born South Asian | <5 | 603,809 | | <5 | 814,101 | | <5 | 1,417,910 | |
| Foreign-born South Asian | 23 | 1,593,537 | 2.4 (1.4–3.8) | 54 | 2,004,359 | 3.0 (2.2–4.3) | 77 | 3,597,896 | 2.8 (2.2–3.6) |
| Vietnamese | 258 | 3,264,276 | 14.7 (12.8–16.7) | 367 | 2,995,872 | 13.8 (12.4–15.3) | 625 | 6,260,148 | 14.1 (13.0–15.3) |
| U.S.-born Vietnamese | <5 | 739,613 | | <5 | 857,673 | | 8 | 1,597,286 | 5.7 (2.1–12.0) |
| Foreign-born Vietnamese | 254 | 2,524,663 | 14.7 (12.9–16.8) | 363 | 2,138,199 | 14.0 (12.6–16.1) | 617 | 4,662,862 | 14.3 (13.2–15.6) |

Abbreviations: IR, incidence rate.

**Table 3:**

Annual Percent Change and Joinpoint Analysis of Incidence Rates for Hepatocellular Carcinoma in Males, by Race/Ethnicity and Nativity, California, 1988–2014

| | 1988–2014 APC (95% CI) | Segment 1 | APC 1 (95% CI) | Segment 2 | APC 2 (95% CI) |
|---|---|---|---|---|---|
| All | 4.1 (3.7–4.5)[a] | 1988–2009 | 5.0 (4.7–5.3)[a] | 2009–2014 | −0.5 (−2.0–1.1) |
| Non-Hispanic White | 4.9 (4.6–5.3)[a] | 1988–2009 | 5.6 (5.1–6)[a] | 2009–2014 | 1.6 (−0.8–4.1) |
| Non-Hispanic Black | 3.9 (3.2–4.7)[a] | 1988–2007 | 5.5 (4.5–6.5)[a] | 2007–2014 | −0.1 (−2.8–2.6) |
| Hispanic | 3.9 (3.3–4.4)[a] | 1988–2010 | 4.6 (4–5.3)[a] | 2010–2014 | −1.3 (−5.4–3.0) |
| U.S.-born Hispanic | 5.1 (4.4–5.9)[a] | 1988–2000 | 9.0 (6.1–12)[a] | 2000–2014 | 3.8 (2.7–4.9)[a] |
| Foreign-born Hispanic | 3.0 (2.3–3.8)[a] | 1988–2014 | 3.0 (2.3–3.8)[a] | | |
| Chinese | −1.5 (−2.1 to −0.9)[a] | 1988–2009 | −0.7 (−1.5–0.1) | 2009–2014 | −6.8 (−12.1 to −1.2)[a] |
| U.S.-born Chinese | −2.1 (−3.7 to −0.6)[a] | 1988–2014 | −2.1 (−3.7 to −0.6)[a] | | |
| Foreign-born Chinese | −1.5 (−2.2 to −0.8)[a] | 1988–2009 | −0.6 (−1.5–0.3) | 2009–2014 | −7.1 (−13.0 to −0.8)[a] |
| Japanese | 1.9 (0.1–3.7)[a] | 1988–2011 | 3.4 (1.6–5.2)[a] | 2011–2014 | −25.7 (−47.9–6.1) |
| U.S.-born Japanese | 2.8 (0.7–5.0)[a] | 1988–2009 | 5.2 (2.3–8.1)[a] | 2009–2014 | −12.9 (−28.2–5.6) |
| Foreign-born Japanese | −0.9 (−3.8–2.1) | 1988–2014 | −0.9 (−3.8–2.1) | | |
| Filipino | 1.1 (0.3–1.8)[a] | 1988–2014 | 1.1 (0.3–1.8)[a] | | |
| U.S.-born Filipino | 2.7 (−4.8–10.7)[b] | 1989–2013 | 2.7 (−4.8–10.7)[b] | | |
| Foreign-born Filipino | 1.0 (0.2–1.7)[a] | 1988–2014 | 1.0 (0.2–1.7)[a] | | |
| Korean | −1.2 (−2.5–0.1) | 1988–2005 | 1.4 (−1.1–3.9) | 2005–2014 | −5.9 (−10.5 to −1.1)[a] |
| U.S.-born Korean[c] | | | | | |
| Foreign-born Korean | −1.4 (−2.6 to −0.1)[a] | 1988–2006 | 1.3 (−0.4–3.1) | 2006–2014 | −7.7 (−11.9 to −3.2)[a] |
| South Asian | 1.0 (−2.3–4.3)[b] | 1989–2013 | 1.0 (−2.3–4.3)[b] | | |
| U.S.-born South Asian[c] | | | | | |
| Foreign-born South Asian | 1.1 (−2.3–4.6)[b] | 1989–2013 | 1.1 (−2.3–4.6)[b] | | |

| | 1988–2014 APC (95% CI) | Segment 1 | APC 1 (95% CI) | Segment 2 | APC 2 (95% CI) |
|---|---|---|---|---|---|
| Vietnamese | −0.8 (−1.7–0.1) | 1988–2014 | −0.8 (−1.7–0.1) | | |
| U.S.-born Vietnamese[c] | | | | | |
| Foreign-born Vietnamese | −0.9 (−1.8–0.1) | 1988–2007 | 0.8 (−0.9–2.5) | 2007–2014 | −4.7 (−8.5 to −0.7)[a] |

[a] Significantly different from zero ($P < 0.05$).

[b] Based on 3-year rates.

[c] Could not estimate. The calculation of 3-year rates require data points for each year within the 3-year span. If there were no cases in one or more years, then 3-year rates could not be calculated.

Abbreviations: APC, annual percent change.

**Table 4:**

Annual Percent Change and Joinpoint Analysis of Incidence Rates for Hepatocellular Carcinoma in Females, by Race/Ethnicity and Nativity, California, 1988–2014

| | 1988–2014 APC (95% CI) | Segment 1 | APC 1 (95% CI) | Segment 2 | APC 2 (95% CI) |
|---|---|---|---|---|---|
| **All** | 3.8 (3.4–4.2)[a] | 1988–2001 | 5.7 (4.5–6.8)[a] | 2001–2014 | 2.6 (1.9–3.3)[a] |
| Non-Hispanic White | 3.9 (3.5–4.3)[a] | 1988–2014 | 3.9 (3.5–4.3)[a] | | |
| Non-Hispanic Black | 3.2 (2.3–4.1)[a] | 1988–2014 | 3.2 (2.3–4.1)[a] | | |
| Hispanic | 3.6 (3.0–4.3)[a] | 1988–2014 | 3.6 (3–4.3)[a] | | |
| U.S.-born Hispanic | 5.1 (4.1–6.1)[a] | 1988–2000 | 9.0 (4.9–13.3)[a] | 2000–2014 | 3.6 (2.0–5.3)[a] |
| Foreign-born Hispanic | 2.9 (2.1–3.6)[a] | 1988–2014 | 2.9 (2.1–3.6)[a] | | |
| Chinese | −0.1 (−1.2–1.0) | 1988–2008 | 1.6 (0.2–3.1)[a] | 2008–2014 | −7.4 (−13.2 to −1.3)[a] |
| U.S.-born Chinese[c] | | | | | |
| Foreign-born Chinese | −0.3 (−1.5–1.0) | 1988–2009 | 1.4 (−0.2–2.9) | 2009–2014 | −10.0 (−18.4 to −0.7)[a] |
| Japanese | 0.2 (−1.7–2.2) | 1988–2008 | 3.3 (1.5–5.1)[a] | 2008–2014 | −17.3 (−26.6 to −7.0)[a] |
| U.S.-born Japanese | 0.9 (−2.7–4.6)[b] | 1989–2007 | 4.2 (−0.5–9.1)[b] | 2007–2013 | −10.7 (−28.5–11.6)[b] |
| Foreign-born Japanese | 0.0 (−2.1–2.1) | 1988–2008 | 3.0 (0.9–5.2)[a] | 2008–2014 | −18.0 (−28.5 to −6.0)[a] |
| Filipino | 1.1 (−0.7–2.9) | 1988–2014 | 1.1 (−0.8–3.0) | | |
| U.S.-born Filipino[c] | | | | | |
| Foreign-born Filipino | 1.1 (−0.8–3.0) | 1988–2014 | 1.1 (−0.8–3.0) | | |
| Korean | −2.2 (−3.8 to −0.5)[a] | 1988–2001 | 2.5 (−2.8–8.1) | 2001–2014 | −5.3 (−8.8 to −1.7)[a] |
| U.S.-born Korean[c] | | | | | |
| Foreign-born Korean | −2.1 (−3.8 to −0.4)[a] | 1988–2014 | −2.1 (−3.8 to −0.4)[a] | | |
| South Asian | −0.3 (−4.7–4.2)[b] | 1989–2013 | −0.3 (−4.7–4.2)[b] | | |
| U.S.-born South Asian[c] | | | | | |
| Foreign-born South Asian | −0.5 (−5.2–4.5)[b] | 1989–2013 | −0.5 (−5.2–4.5)[b] | | |

| | 1988–2014 APC (95% CI) | Segment 1 | APC 1 (95% CI) | Segment 2 | APC 2 (95% CI) |
|---|---|---|---|---|---|
| Vietnamese | −1.0 (−2.7–0.7) | 1988–1993 | 53.2 (6.5–120.2)[a] | 1993–2014 | −2.0 (−3.5 to −0.6)[a] |
| U.S.-born Vietnamese[c] | | | | | |
| Foreign-born Vietnamese | −1.0 (−2.7–0.8) | 1988–1993 | 53.3 (5.0–123.8)[a] | 1993–2014 | −2.0 (−3.5 to −0.5)[a] |

[a]Significantly different from zero ($P < 0.05$).

[b]Based on 3-year rates.

[c]Could not estimate. The calculation of 3-year rates require data points for each year within the 3-year span. If there were no cases in one or more years, then 3-year rates could not be calculated.

Abbreviations: APC, annual percent change.

**Table 5:**

Summary of Findings

| | Time | Sex | Race/ethnicity | Nativity |
|---|---|---|---|---|
| HCC incidence rates (IRs) | For both males and females, IRs were higher in the later time period (2005–2014) than the early time periods, except for Chinese, Koreans, and Vietnamese. | For both early and late time periods and regardless of race/ethnicity, males had higher HCC IRs than females. | For both males and females and both early and late time periods, all racial/ethnic groups had higher HCC IRs than NHWs, except Japanese and South Asian males during the late time period (2005–2014). | IRs were lower for foreign-born than U.S.-born Hispanic and South Asian males; there was no difference in HCC IRs by nativity for Hispanic females and Filipino males and females; for all other Asian groups, HCC IRs were higher for foreign-born than U.S.-born, regardless of sex. |
| Trends and annual percent change (APC) in HCC incidence | | APCs were similar in magnitude among males and females. | For both males and females, incidence was increasing for NHWs, NHBs, and Hispanics but either increasing at a slower rate, plateauing, or decreasing among Asian groups.<br>For both males and females, joinpoint analysis show large decreases in incidence trends for Asian groups in more recent years.<br>Among males, NHW, NHB and Hispanic APCs were becoming more stable in more recent years. | For both males and females, U.S.-borns had larger increases in incidence than foreign-borns, however, in joinpoint analysis, APCs for U.S.-borns and foreign-borns became equivalent in more recent years. |
| Key findings | • Regardless of time period, males continue to have higher HCC incidence than females.<br>• Regardless of time period or sex, NHWs continue to have lower HCC incidence than all other racial/ethnic groups.<br>• Regardless of sex, there is an overall increase in HCC incidence with time in the aggregate study population.<br>• Regardless of sex, there is heterogeneity in HCC incidence patterns when data is disaggregated by race/ethnicity (especially for Asians), with decreasing incidence trends for some Asian groups in more recent years.<br>• Regardless of sex, for most Asian groups, foreign-born have higher HCC incidence than U.S.-born.<br>• Among males only, HCC incidence is lower for foreign-born than U.S.-born Hispanics. | | | |

Abbreviations: HCC, hepatocellular carcinoma; IR, incidence rate; APC, annual percent change.