# The Burden of Liver Cancer in Asians and Pacific Islanders in the Greater San Francisco Bay Area, 1990 Through 2004

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**BACKGROUND.** To the authors' knowledge, no previous U.S. study has examined time trends in the incidence rate of liver cancer in the high-risk Asian/Pacific Islander population. In this study, liver cancer incidence trends were evaluated in Chinese, Filipino, Japanese, Korean, and Vietnamese men and women in the Greater San Francisco Bay Area of California between 1990 and 2004.

**METHODS.** Populations at risk were estimated by using the cohort-component demographic method. Annual percentage changes (APCs) in age-adjusted incidence rates of primary liver cancer among Asians/Pacific Islanders in the Greater Bay Area Cancer Registry were calculated by using joinpoint regression analysis.

**RESULTS.** The incidence rate of liver cancer between 1990 and 2004 did not change significantly in Asian/Pacific Islander men or women overall. However, the incidence rate declined, although the decline was not statistically significant, among Chinese men (APC, −1.6%; 95% confidence interval [95% CI], −3.4–0.3%), Japanese men (APC, −4.9%; 95% CI, −10.7–1.2%), and Japanese women (APC, −3.6%; 95% CI, −8.9–2%). Incidence rates remained consistently high for Vietnamese, Korean, and Filipino men and women. Trends in the incidence rate of hepatocellular carcinoma were comparable to those for liver cancer. Although disparities in liver cancer incidence between Asians/Pacific Islanders and other racial/ethnic groups diminished between the period from 1990 through 1994 and the period from 2000 through 2004, the disparities among Asian subgroups increased.

**CONCLUSIONS.** Liver cancer continues to affect Asian/Pacific Islander Americans disproportionately, with consistently high incidence rates in most subgroups. Culturally targeted prevention methods are needed to reduce the high rates of liver cancer in this growing population in the U.S. ***Cancer*** **2007;109:2100–8.** *© 2007 American Cancer Society.*

**KEYWORDS: Asian Americans, epidemiology, hepatocellular carcinoma, liver cancer, surveillance.**

Liver cancer is the sixth most common newly diagnosed cancer and the third most common cause of cancer mortality in the world.[1] Although >80% of liver cancer cases worldwide occur in developing parts of the world, particularly in Asia, Melanesia, and

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Africa,[1] a sizeable and growing proportion of the U.S. population—particularly immigrants from high-incidence regions—is at elevated risk of developing liver cancer. Previous studies have examined the incidence rate of liver cancer in U.S. white, black, and Hispanic populations,[2,3] in whom the incidence rate of hepatocellular carcinoma (HCC) rose by >90% between 1976 and 2000.[4] However, none of those studies examined trends in Asian/Pacific Islander (API) Americans—the racial group with the highest risk of liver cancer[5] and with the fastest growth rate in the U.S.[6] Moreover, because the classification of APIs into an aggregated racial group—an established practice in population and health statistics—ignores the substantial heterogeneity among dozens of racial/ethnic subgroups, little is known about the pattern of disease occurrence, including changes in incidence over time, within such subgroups. Consequently, culturally targeted interventions designed to improve the prevention of and screening for liver cancer based on aggregated statistics may not be aimed at the Asian subgroups at the greatest risk.

The Greater San Francisco Bay Area in California has the highest concentration of APIs in the continental U.S (23%),[7] making it an ideal region in which to examine cancer incidence patterns across Asian subgroups. Therefore, we set out to evaluate secular trends in liver cancer incidence rates for APIs combined and in Chinese, Japanese, Filipino, Korean, and Vietnamese men and women between 1990 and 2004. We also assessed secular changes in the burden of liver cancer, which we measured as the difference between the proportion of liver cancer cases and the proportion of the total population represented by specific Asian subgroups, and the rank of liver cancer among all cancer sites.

## MATERIALS AND METHODS

### Case Data

The patients who were included in this study had incident cases of primary malignant liver cancer (International Classification of Diseases for Oncology, second edition [ICD-O-2][8] or ICD-O-3[9] site code 22.0; histology codes 8000–8999) diagnosed between January 1, 1990 and December 31, 2004 while they resided in the 9 counties of the Greater San Francisco Bay Area that form the catchment area for the Greater Bay Area Cancer Registry (GBACR). The GBACR is a participant in the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program and in the state-mandated California Cancer Registry. Secondary analyses were limited to HCC (ICD-O-2 or ICD-O-3 histology codes 8170–8180), which is the predominant form of liver cancer. Information regarding patients' race/ethnicity in the GBACR is obtained routinely from hospital medical records, in which it is collected primarily through patient self-report, although it sometimes also may be collected by assumption of hospital personnel or from inference based on other information, including race/ethnicity of parents, birthplace, maiden name, or surname.[10]

### Population Data

Updated, annual, midyear population estimates between 1990 and 2004 were provided by the State of California Department of Finance (DOF) Demographic Research Unit by age, sex, and race/ethnicity for each county. Because the DOF does not estimate annual population counts for Asian-American (hereafter referred to as "Asian") subgroups, we computed annual population estimates between 1990 and 2004 separately for the 6 largest Asian populations in the Greater San Francisco Bay Area: Chinese, Filipino, Japanese, Korean, South Asian, and Vietnamese. We also analyzed all APIs combined, including these 6 groups as well as APIs of other or unknown subgroups. Because of sparse cancer case numbers, analyses were not conducted for South Asians as a separate subgroup. Hispanic Asians were excluded, because they comprise a distinct ethnic group.

For the Census years 1990 and 2000, we used Census totals (from the 100% sample) as population estimates. Because respondents were allowed to identify with >1 race category in the 2000 Census, we used a bridging methodology to reallocate all multirace individuals (10% of APIs in the GBACR region[11]) into single-race categories by using allocation percentages provided by the DOF.[12,13] For the intercensal years 1991 through 1999, we used the same DOF cohort-component method[14] to estimate the annual age-, sex-, and county-specific intercensal population for each Asian subgroup by using the population counts from 1990 and 2000, incorporating annual DOF immigration data for each county, and incorporating birth and death counts from vital statistics data for each year within the intercensal period. We estimated postcensal (2001 through 2004) populations by extrapolation from the 2000 populations by using a constant allocation method within each county and sex. Based on this method, the relative proportions of each age-specific Asian subgroup in 2000 were applied to the bridged 2001 through 2004 combined Asian population for the same county and sex groups.

Incidence rates were compared by using bridged and unbridged population estimates, and the differences were insubstantial. Here, we present bridged estimates, since they are likely to yield a more accurate estimate of the true incidence rate because of the high proportion of multirace individuals in relatively small Asian subgroups.

The population estimates used in this study are generally <10% different from the SEER Program's estimates provided by the U.S. Bureau of the Census (unpublished observations). However, the Census estimates for APIs tend to be higher in groups aged ≥70 years during the intercensal period. Both population estimates use bridging methods to allocate multirace individuals into single-race groups based on different allocation percentages. Age adjustment of rates tends to smooth over any differences between the population estimates.

### Statistical Analysis

We used SEER*Stat software[15] to compute average, annual, age-adjusted incidence rates of cancer (standardized to the 2000 U.S. standard million population) and 95% confidence intervals (95% CIs) for men and women. Time trends in the incidence rate between 1990 and 2004 were analyzed by using Joinpoint Regression Program software[16,17] to fit a series of regression lines to the age-adjusted incidence rates on the logarithmic scale, and we used calendar year as the regressor variable. The slope of each line segment describes the annual percentage change (APC) in the incidence rate, and line segments are connected at "joinpoints" that denote a statistically significant change in trend ($P < .05$). A minimum of zero joinpoints (1 line segment) and a maximum of 3 joinpoints (4 line segments) were allowed for each model, which was selected to minimize the number of joinpoints needed for the best fit. A minimum of 2 observations was required between joinpoints or from a joinpoint to either end of the data.

To summarize secular trends graphically, we grouped age-adjusted incidence rates by 5-year periods (1990–1994, 1995–1999, and 2000–2004) to stabilize estimates and to examine other changes in the relative incidence and mortality of liver cancer over time. Specifically, we quantified the burden of liver cancer as the proportion of liver cancer cases in APIs or in each Asian subgroup, divided by the proportion of the total Greater San Francisco Bay Area population (including both APIs and non-APIs) represented by that group. We also assessed the relative importance of liver cancer within each group by ranking the frequency of liver cancer incidence or mortality among all invasive cancer sites in the GBACR at the start of the study period (1990–1994) and at the end (2000–2004). Cancers of the oral cavity and pharynx, the colon and rectum, or the brain and nervous system were grouped together for the latter analysis, in accordance with similar ranking methods.[18]

To quantify racial/ethnic disparities in liver cancer incidence, we compared APIs with non-APIs (including non-Hispanic whites, non-Hispanic blacks, Hispanics, and others) and compared Asian subgroups with one another by using 3 summary measures. The between-group variance was used to measure the absolute level of racial/ethnic disparity in the age-adjusted incidence rate of liver cancer over time, whereas the Theil index and the mean log deviation were used to measure the relative level of racial/ethnic disparity.[19] The Theil index is influenced more by population subgroups with relatively high incidence rates, whereas the mean log deviation is influenced more by population subgroups of larger size.

## RESULTS

Incidence rates of liver cancer in Asian subgroups in the Greater San Francisco Bay Area between 1990 and 2004 ranged from 6.9 to 65.7 per 100,000 person-years among men and 4.5 to 23.9 per 100,000 person-years among women (Table 1). From 2000 through 2004, liver cancer incidence rates per 100,000 person-years among men were 6.6 (95% CI, 6–7.1) in non-Hispanic whites, 15.3 (95% CI, 12.9–18.2) in non-Hispanic blacks, and 15.1 (95% CI, 13.2–17.3) in Hispanics. Among women, the corresponding rates were 2.1 (95% CI, 1.8–2.4) in non-Hispanic whites, 4.8 (95% CI, 3.6–6.3) in non-Hispanic blacks, and 5.8 (95% CI, 4.8–7) in Hispanics. By comparison, age-adjusted incidence rates (standardized to the 2000 U.S. standard million population) of liver cancer in China, Japan, Korea, Vietnam, and the Philippines between 1993 and 1997 generally ranged from 30 to 70 per 100,000 person-years among men and from 10 to 20 per 100,000 person-years among women.[20]

The liver cancer incidence rate in API men overall concealed heterogeneity in rates and time trends among Asian subgroups (Fig. 1,) (Table 1). The rate of liver cancer over time decreased marginally in Chinese men and Japanese men, whereas it was relatively stable in Filipino, Korean, and Vietnamese men. Incidence rates consistently were highest in Vietnamese men, followed by Korean or Chinese men, then Filipino and Japanese men. In API women, the level trend again disguised considerable variation among Asian subgroups, with a suggestive rate decline in Japanese women but with no significant change in Chinese, Filipina, or Vietnamese women.

TABLE 1
Age-Adjusted Incidence Rates of Liver Cancer Over Time in Asian Subgroups: Incidence Rate of Primary Liver Cancer per 100,000 Person-years, Age Standardized to the 2000 United States Population, With 95% Confidence Intervals and Annual Percentage Change in Rates Among Asians/Pacific Islanders and Subgroups in the Greater San Francisco Bay Area, 1990–2004

| | 1990–1994 | | | 1995–1999 | | | 2000–2004 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Race/ethnicity | Cases, no. | Rate | 95% CI | Cases, no. | Rate | 95% CI | Cases, no. | Rate | 95% CI | APC, % | 95% CI, % |
| Men | | | | | | | | | | | |
| Asian/Pacific Islander | 389 | 24.7 | 22.2–27.5 | 519 | 24.9 | 22.7–27.3 | 661 | 22.9 | 21.2–24.8 | −0.4 | −1.8–1 |
| Chinese | 198 | 28.8 | 24.7–33.7 | 264 | 29.1 | 25.5–33.1 | 297 | 24.1 | 21.4–27.1 | −1.6 | −3.4–0.3 |
| Filipino | 64 | 16.6 | 12.7–21.5 | 63 | 12.8 | 9.7–16.8 | 104 | 16.1 | 13.1–19.6 | −0.3 | −3.2–2.8 |
| Japanese | 21 | 14.1 | 8.2–23.7 | 22 | 11.8 | 7.2–19.4 | 17 | 6.9 | 4–11.5 | −4.9 | −10.7–1.2 |
| Korean | 17 | 26.9 | 15.2–57.6 | 31 | 39.1 | 25.5–61.3 | 34 | 33.6 | 22.5–49.5 | 1.9 | −2.8–6.9 |
| Vietnamese | 55 | 55.6 | 39.3–83.9 | 102 | 65.7 | 50.8–85.5 | 135 | 53 | 43.6–64.6 | 0.2 | −4.4–5.1 |
| Women | | | | | | | | | | | |
| Asian/Pacific Islander | 134 | 7.7 | 6.4–9.3 | 212 | 8.5 | 7.3–9.8 | 233 | 6.7 | 5.9–7.7 | −1.2 | −3.3–1.1 |
| Chinese | 62 | 8.5 | 6.5–11 | 83 | 7.8 | 6.2–9.7 | 96 | 6.6 | 5.3–8.1 | −1.8 | −4.8–1.3 |
| Filipina | 22 | 5.4 | 3.1–9.1 | 34 | 5.8 | 3.9–8.4 | 38 | 4.5 | 3.2–6.3 | −2.3 | −6.5–2.4 |
| Japanese | 23 | 8.3 | 4.9–13.9 | 23 | 6.7 | 4.2–10.9 | 22 | 5.2 | 3.2–8.7 | −3.6 | −8.9–2 |
| Korean | 5 | 8.1 | 2.5–23.9 | 16 | 15.2 | 8.4–26.5 | 16 | 12.1 | 6.8–20.3 | — | |
| Vietnamese | 14 | 13.3 | 6.9–27.6 | 39 | 23.9 | 16.4–34.8 | 37 | 14.5 | 10.1–20.6 | −0.1 | −6.9–7.3 |

95% CI indicates 95% confidence interval; APC, annual percentage change.

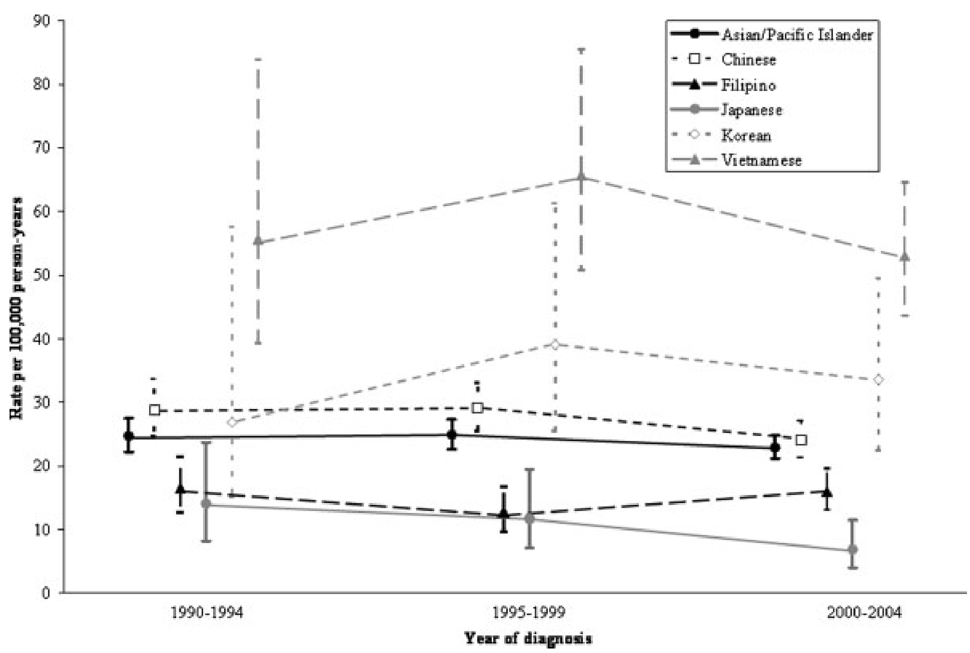


**FIGURE 1.** Age-adjusted incidence rate of liver cancer in the Greater San Francisco Bay Area among Asian/Pacific Islander men from 1990 through 2004. Data points are offset for visibility. Error bars denote 95% confidence intervals.

The incidence rate of liver cancer appeared to have increased over time in Korean women (Fig. 2,) (Table 1), but the APC could not be estimated because of limited case numbers. Incidence rates were highest in Vietnamese and Korean women followed by Chinese, Japanese, and Filipina women.

HCC comprised >90% of primary liver cancers in men and >85% in women in most Asian subgroups; these proportions did not vary substantially over time (data not shown). Therefore, secular trends for HCC between 1990 and 2004 closely paralleled those for liver cancer overall, with indications of a decrease among Chinese men (APC, −1.5%; 95% CI, −3.5–0.6%), Japanese men (APC, −4.4%; 95% CI, −10.4–2.1%), and Japanese women (APC, −2.9%; 95% CI, −8.3–2.7%; other data not shown).

The burden of incident liver cancer was greatest among Chinese and Vietnamese men and among Korean and Vietnamese women relative to the total Greater San Francisco Bay Area population (Table 2).

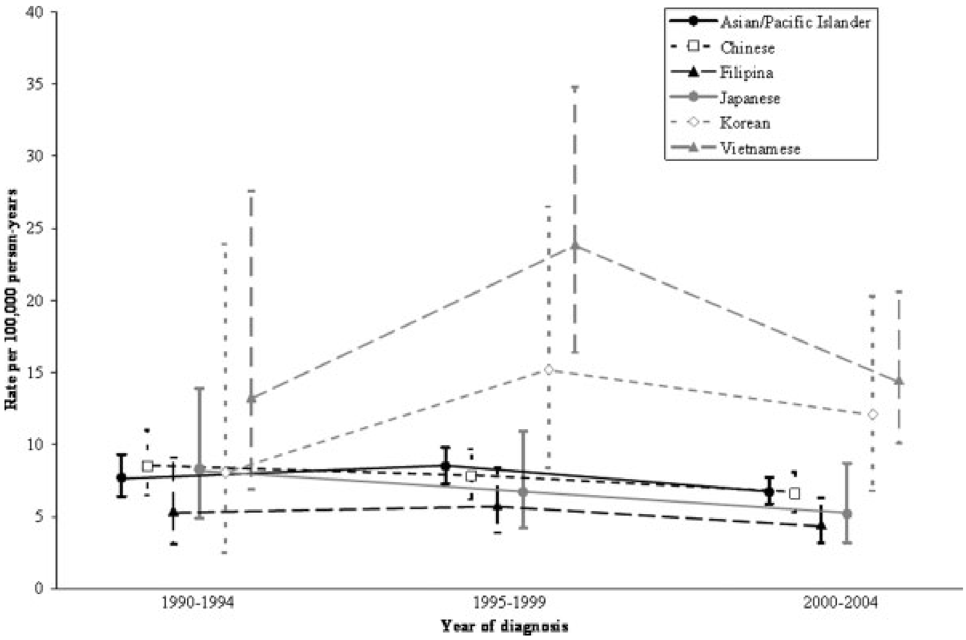


**FIGURE 2.** Age-adjusted incidence rate of liver cancer in the Greater San Francisco Bay Area among Asian/Pacific Islander women from 1990 through 2004. Data points are offset for visibility. Error bars denote 95% confidence intervals.

**TABLE 2**
**Burden of Liver Cancer Over Time in Asian Subgroups: Asian/Pacific Islanders and Subgroups as a Proportion of the Total Population or of All Primary Liver Cancer Cases and the Relative Difference Between Proportions in the Greater San Francisco Bay Area, 1990–1994 and 2000–2004**

| | Men | | | | | | Women | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1990–1994 | | | 2000–2004 | | | 1990–1994 | | | 2000–2004 | | |
| Race/ethnicity | Population, % | Cases, % | Fold difference | Population, % | Cases, % | Fold difference | Population, % | Cases, % | Fold difference | Population, % | Cases, % | Fold difference |
| Asian/Pacific Islander | 16.1 | 42 | 2.6 | 21.6 | 39.3 | 1.8 | 16.8 | 37.4 | 2.2 | 22.8 | 37.2 | 1.6 |
| Chinese | 5.8 | 21.4 | 3.7 | 7.7 | 17.6 | 2.3 | 6.1 | 17.3 | 2.8 | 8.2 | 15.3 | 1.9 |
| Filipino | 3.9 | 6.9 | 1.8 | 4.9 | 6.2 | 1.3 | 4.3 | 6.1 | 1.4 | 5.5 | 6.1 | 1.1 |
| Japanese | 1.2 | 2.3 | 1.9 | 1.4 | 1 | 0.7 | 1.4 | 6.4 | 4.5 | 1.7 | 3.5 | 2.1 |
| Korean | 0.7 | 1.8 | 2.5 | 0.9 | 2 | 2.2 | 0.9 | 1.4 | 1.6 | 1.1 | 2.6 | 2.4 |
| Vietnamese | 1.7 | 5.9 | 3.4 | 2.4 | 8 | 3.3 | 1.6 | 3.9 | 2.5 | 2.4 | 5.9 | 2.5 |

Disparities in liver cancer incidence were somewhat lessened over time, because the imbalance among Asian subgroups—with some exceptions, such as Vietnamese men and women—generally diminished between the period from 1990 through 1994 and the period from 2000 through 2004 (with intermediate values during the period from 1995 through 1999; data not shown).

Liver cancer was a leading cause of cancer incidence and death in API men, ranking among the 5 most common cancer sites for most Asian subgroups (Table 3). Because survival with liver cancer is poorer than that of most other cancer sites, its ranking as a cause of cancer mortality generally was higher than that for cancer incidence. In women, liver cancer generally ranked lower than in men as a cause of cancer incidence and mortality (Table 3), reflecting the roughly 3:1 ratio of men to women in most racial/ethnic groups (Table 1). Nevertheless, liver cancer was 1 of the 7 most common causes of cancer death among women in all Asian subgroups from 2000 to 2004. The ranking of liver cancer incidence and mortality among all cancer sites remained in the top 14 for incidence and the top 10 for mortality between the period from 1990 through 1994 and the period from 2000 through 2004 (including the period from 1995 through 1999, data not shown) in all subgroups of Asian men and women.

Summary measures of health disparity comparing APIs with non-APIs overall showed that both the absolute and the relative racial/ethnic disparity in the age-adjusted incidence rate of liver cancer diminished over time (Table 4) (1995–1999 data not shown). However, the absolute and relative disparity

TABLE 3
Relative Importance of Liver Cancer Over Time in Asian Subgroups: The Rank of Primary Liver Cancer Incidence and Mortality Among All Cancer Sites in Asians/Pacific Islanders and Subgroups in the Greater San Francisco Bay Area, 1990–1994 and 2000–2004

| | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|
| | Incidence | | Mortality | | Incidence | | Mortality | |
| Race/Ethnicity | 1990–1994 | 2000–2004 | 1990–1994 | 2000–2004 | 1990–1994 | 2000–2004 | 1990–1994 | 2000–2004 |
| Asian/Pacific Islander | 4th | 4th | 2nd | 3rd | 12th | 11th | 5th | 6th |
| Chinese | 4th | 4th | 2nd | 2nd | 11th | 10th | 4th | 6th |
| Filipino | 5th | 5th | 4th | 5th | 14th | 13th | 10th | 7th |
| Japanese | 8th | 10th | 7th | 6th | 8th | 9th | 6th | 7th |
| Korean | 4th | 3rd | 3rd | 4th | 7th | 5th | 4th | 5th |
| Vietnamese | 2nd | 2nd | 2nd | 2nd | 8th | 6th | 6th | 3rd |

TABLE 4
Summary Metrics of Disparities in Liver Cancer Incidence Over Time: Absolute (Between-Group Variation) and Relative (Theil Index and Mean Log Deviation) Measures of Disparities in the Age-adjusted Incidence Rate of Liver Cancer Comparing Asians/Pacific Islanders With Non-Asians/Pacific Islanders and Comparing Asian Subgroups, 1990–1994 and 2000–2004

| | Asian/Pacific Islander vs Non-Asian/Pacific Islander | | Chinese vs Filipino vs Japanese vs Korean vs Vietnamese | |
|---|---|---|---|---|
| Measure of disparity | 1990–1994 | 2000–2004 | 1990–1994 | 2000–2004 |
| Men | | | | |
| Between-group variation | 42.72 | 34.01 | 158.68 | 165.30 |
| Theil index | 0.28 | 0.12 | 0.19 | 0.20 |
| Mean log deviation | 0.14 | 0.08 | 0.01 | 0.05 |
| Women | | | | |
| Between-group variation | 4.11 | 2.59 | 5.31 | 10.92 |
| Theil index | 0.32 | 0.10 | 0.06 | 0.17 |
| Mean log deviation | 0.09 | 0.06 | 0.02 | 0.02 |

in liver cancer incidence among Asian subgroups increased during the same period.

## DISCUSSION

In the current study, we observed that that the high incidence rate of liver cancer (and HCC in particular) among the API population of the Greater San Francisco Bay Area remained steady in APIs overall and in most Asian subgroups between 1990 and 2004, with differences in rates and trends noted across subgroups. Although the rate decreased in Chinese men and in Japanese men and women, it did not change significantly in Vietnamese or Korean men or women—that is, in the subgroups with the highest incidence rates of liver cancer—nor did it change appreciably in Chinese women or Filipinos. Although national incidence rates and time trends are not available for API subgroups, our findings among all APIs combined in the Greater San Francisco Bay Area were comparable with those for APIs in the overall United States (incidence rate of liver and intrahepatic bile duct cancer from 1999 through 2003: 22.1 per 100,000 person-years in API men and 8.3 per 100,000 person-years in API women; no significant change from 1995 through 2003).[3] The stable or decreasing trends in API subgroups in the Greater San Francisco Bay Area are at variance with the rising liver cancer incidence in other racial/ethnic groups in the U.S. over recent decades.[2–4] The enduring high incidence rates in APIs and Asian subgroups, combined with the escalating trends in Hispanics, whites, and blacks, make it clear that enhancing liver cancer awareness and prevention is a major public health priority for all Americans.

The increasing liver cancer incidence rates in Hispanics, whites, and blacks generally have been attributed to the spread of hepatitis C virus (HCV) infection in the U.S., as reflected by the 2- to 4-fold increase in the incidence of acute HCV infection between the early 1960s and the late 1980s.[21] In contrast, the disproportionately high rate of liver cancer incidence in APIs is ascribed primarily to the high prevalence of chronic hepatitis B virus (HBV) infection, which is associated etiologically with the majority of liver cancer in Asian natives and migrants.[22,23] Chronic HBV infection is carried by approximately 10% of the population in eastern and southeastern Asia and sub-Saharan Africa, as well as immigrants from those regions, whereas its prevalence is estimated at <0.5% in the overall U.S. population.[24] The suggestion of a decline in the Chinese and Japanese populations may be caused in part by the finding that immigrants from China and Japan have been settling in the U.S. since the middle of the 19th century.[25] Because HBV is nonendemic in the U.S., acculturated Asians may be less likely than more recently immigrated Asians to acquire HBV infection through horizontal transmission in early childhood or adulthood. Lower rates of transmission, in turn, reduce the prevalence of chronic HBV infection, which most commonly follows infection during early childhood or birth to an infected mother.[24] In concert with our results showing a flat or even decreasing time trend in liver cancer incidence in Asian subgroups, the results from 2 U.S.-based studies indicated that the occurrence of HBV-related liver cancer in Veterans Affairs Medical Centers[26] and in a Houston medical center[27] remained stable or declined between 1993 and 1998.

Although a safe and effective vaccine against HBV has existed since 1982,[28] the population-wide incidence rate of liver cancer in APIs and in most Asian subgroups may not have decreased yet, because liver cancer usually occurs in adults, many of whom were infected chronically with HBV before the vaccine was introduced. Nevertheless, few Asian countries—with the exception of Taiwan[29,30] and Malaysia[31]—have been quick to adopt universal newborn HBV vaccination programs, and the majority of APIs in the U.S. are foreign-born.[32] Therefore, the continuing influx of API immigrants into the U.S.[6] likely will sustain the high prevalence of chronic HBV infection and the high incidence rate of liver cancer in API adults for several years to come, unless preventive public health steps are taken.

Further evidence of the need for preventive measures is provided by the persistence of liver cancer as a leading cause of cancer mortality in APIs and in all Asian subgroups in our study, suggesting that chronic HBV carriers are not being identified, treated for chronic HBV infection,[33] and screened regularly for early liver cancer, which is more amenable to treatment when detected early.[34] Although the U.S. Advisory Committee on Immunization Practices recommends universal vaccination of newborns, children, adolescents, and high-risk adults (including heterosexuals with multiple sex partners, injection-drug users, and men who have sex with men),[35,36] there is no recommendation for HBV testing in all APIs, nor are there universally accepted guidelines for liver cancer screening. Furthermore, APIs are not recognized broadly as a high-risk group, creating barriers in access to HBV testing and vaccination for API adults.

Some limitations of our study should be considered. We lacked data regarding whether cases pf liver cancer were secondary to chronic HBV or HCV infection, alcoholic cirrhosis, or a combination of these factors. We also had no knowledge of other risk factors, such as diet, alcohol intake, obesity, or diabetes. Therefore, although incidence rates generally were steady, we were unable to determine whether the proportions of liver cancer associated with certain risk factors changed over time. In general, there are no population-based data on the seroprevalence of chronic HBV infection in Asian subgroups, although the annual incidence rate of acute HBV infection did not change in the overall U.S. population between the late 1970s and the early 1990s.[37]

We also lacked information regarding patients' screening, vaccination, and antiviral treatment[38] practices and, thus, were unable to evaluate whether those activities affected liver cancer incidence. In addition, when quantifying secular changes in the proportion of liver cancer cases compared with the population and in the ranking of liver cancer among all cancer sites, we did not account for variation and changes in the distribution of age or other population characteristics. The ranking of liver cancer incidence and mortality among all cancer sites can be affected by changes in the occurrence of other cancers; however, the high ranking of liver cancer emphasizes that it should be a prominent target in the effort to reduce the nationwide cancer burden. Another limitation is the potential for misclassification of Asian subgroups in cancer registry and/or population data,[39–41] although it is unlikely that such misclassification changed substantially during the study period. Finally, the statistical power of our analysis was limited by the small number of observed liver cancer cases in some population subgroups.

In conclusion, our results demonstrate that liver cancer incidence in the Greater San Francisco Bay Area remained high in API, Vietnamese, Korean, and Filipino men and women and in Chinese women between 1990 and 2004, with some evidence of a decrease among Chinese men and among Japanese men and women. The lack of a decline in most Asian subgroups indicates that liver cancer prevention through HBV testing, vaccination, and treatment, as well as liver cancer screening, remains a top priority in the API population. We also observed that disparities in liver cancer incidence among Asian subgroups widened from 1990 through 2004. In particular, the Vietnamese, Korean, and Filipino populations in the U.S. should be the focus of culturally and linguistically targeted HBV and liver cancer education, prevention, and screening efforts. Such intensified public health efforts are necessary to curtail the expanding nationwide burden of liver cancer in all racial/ethnic groups.

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