

Epidemiology of Non-small Cell Lung Cancer in Asian Americans

Incidence Patterns Among Six Subgroups by Nativity

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Background: Differences in the epidemiology of lung cancer between Asians and non-Hispanic whites have brought to light the relative influences of genetic and environmental factors on lung cancer risk. We set out to describe the epidemiology of non-small cell lung cancer (NSCLC) among Asians living in California, and to explore the effects of acculturation on lung cancer risk by comparing lung cancer rates between U.S.-born and foreign-born Asians.

Methods: Age-adjusted incidence rates of NSCLC were calculated for Chinese, Filipino, Japanese, Korean, Vietnamese, and South Asians in California between 1988 and 2003 using data from the California Cancer Registry. Incidence rates were calculated and stratified by sex and nativity. We analyzed population-based tobacco smoking prevalence data to determine whether differences in rates were associated with prevalence of tobacco smoking.

Results: Asians have overall lower incidence rates of NSCLC compared with whites (29.8 and 57.7 per 100,000, respectively). South Asians have markedly low rates of NSCLC (12.0 per 100,000). Foreign-born Asian men and women have an approximately 35% higher rate of NSCLC than U.S.-born Asian men and women. The incidence pattern by nativity is consistent with the population prevalence of smoking among Asian men; however, among women, the prevalence of smoking is higher among U.S.-born, which is counter to their incidence patterns.

Conclusions: Foreign-born Asians have a higher rate of NSCLC than U.S.-born Asians, which may be due to environmental tobacco

smoke or nontobacco exposures among women. South Asians have a remarkably low rate of NSCLC that approaches white levels among the U.S.-born. More studies with individual-level survey data are needed to identify the specific environmental factors associated with differential lung cancer risk occurring with acculturation among Asians.

Key Words: Lung cancer, Epidemiology, Asian, Nativity, Smoking, Exposures.

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Lung cancer is the most common cause of cancer death in the United States and worldwide.^{1,2} Other than tobacco exposure, factors associated with increased lung cancer risk, such as environmental exposures and genetic susceptibility, are not well understood.³ Differences in the epidemiology of lung cancer among ethnic groups may shed light on possible genetic and environmental influences on lung cancer development. Studies in Asian populations, in particular, have drawn attention to possible links between lung cancer and environmental exposures, other than tobacco smoke.⁴ Relative to other racial/ethnic groups, Asians in general have been reported to have a lower incidence rate of lung cancer,^{4,5} a predisposition to adenocarcinoma and bronchioloalveolar carcinoma (BAC),^{6,7} and a high prevalence of epidermal growth factor receptor mutations.⁸ It is unclear the extent to which genetic factors or environmental exposures account for differences in lung cancer rates among Asians and non-Hispanic whites. The identification of relevant environmental risk factors that explain the lower rates in Asian populations may be useful targets for primary prevention of lung cancer, particularly in nonsmokers. Identification of lung cancer susceptibility genes may help to define high-risk groups for secondary prevention. A detailed examination of rates among detailed Asian subgroups by nativity will lend some clues to the relative contributions of genetic and environmental factors.

With a diverse catchment population encompassing all 4.1 million Asians, including large populations of Chinese, Filipino, South Asian (Asian-Indian and Pakistani), Korean, Japanese, and Vietnamese, the California Cancer Registry

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(CCR) offers a unique population to study the effect of race/ethnicity on the epidemiology of lung cancer.⁹ We set out to describe the epidemiology of non-small cell lung cancer (NSCLC) among Asians living in California, and to explore the effects of acculturation on lung cancer risk by comparing NSCLC rates between U.S.-born and foreign-born Asians. Differences in lung cancer incidence between U.S.-born and foreign-born Asian populations may be explained by environmental exposures, whereas differences in lung cancer incidence between Asians and non-Hispanic whites (hereafter referred to as whites) that are maintained among both U.S.-born and foreign-born Asians may be explained by genetic factors. We hypothesized that both U.S.-born and foreign-born East Asians are at disproportionately high risk for adenocarcinoma and BAC compared with whites. We also posited that the risk of NSCLC among U.S.-born and foreign-born Asians would closely mirror the prevalence of cigarette smoking in these groups.

METHODS

Data were obtained on cases of NSCLC in the CCR diagnosed between 1988 and 2003. Case reporting to the CCR is estimated to be 99% complete (<http://www.ccrca.org/questions.html#how%20complete%20is%20ccr%20data>). NSCLC cases were identified using primary site and histology codes for large cell carcinoma, squamous cell carcinoma, adenocarcinoma, BAC, and nonspecified NSCLC as previously described.¹⁰ This study was reviewed and approved by the institutional review boards at the Northern California Cancer Center and at the University of California San Francisco. No human subjects were contacted for this study.

Race/ethnicity and country of birth were obtained routinely by the CCR from hospital medical records. Patients of Chinese, Filipino, Japanese, Vietnamese, Korean, or South Asian descent were included; these six ethnic groups comprised 91% of all Asian patients in the CCR between 1988 and 2003. Of 14,569 Asians with NSCLC in this study, 4889 cases (34%) were Chinese, 4542 (31%) were Filipino, 2060 (14%) were Japanese, 1618 (11%) were Vietnamese, 1149 (11%) were Korean, and 311 (2%) were South Asian. By comparison, in 2000, the statewide distribution of these six Asian ethnic groups (which comprised 90% of the total Asian population in California) was 29% Chinese, 28% Filipino, 9% Japanese, 13% Vietnamese, 10% Korean, and 10% South Asian. At that time, 36% of all Asians in the United States resided in California.

There was information on country of birth in the CCR for 13,398 (92%) cases. For 1170 cases (8%) with unknown country of birth, the first five digits of the social security number (SSN), which correlates with its year of issuance, and date of birth were used to impute nativity. We had previously found that, compared with self-reported nativity, the sensitivity and positive predictive value of imputing nativity based on SSN and age of issue exceeded 80%. Thus, cases who had received their SSN before age 19 was imputed as being U.S.-born, and those who had received their SSN on or after age 19 was imputed as foreign-born.^{11,12}

Population estimates by sex, race/ethnicity, nativity, and 5-year age group were obtained from the 1990 and 2000 SF-3 census files for the state of California and extracensal estimates were produced by the Greater Bay Area Cancer Registry and the CCR. Population counts for the detailed Asian subgroups for the year 2000 were based on an average of the minimum (single race alone) and maximum (multiple race Asians) estimate for each subgroup. Using the 1990 and 2000 estimates as benchmarks, a linear interpolation and extrapolation method was used to estimate the 1988–1989 and 2001–2003 population data. Linear interpolation and extrapolation assumes a fixed amount of population growth each year. Detailed explanation of this methodology is available elsewhere.¹³ To apply nativity to these estimates, we used the 5% public use microdata sample from the 1990 and 2000 censuses¹⁴; this allowed us to estimate the percent foreign-born by Asian subgroup, sex, and 5-year age group for California. Using linear interpolation, we estimated the percent foreign-born for all intercensal years. Extrapolations beyond the most recent census year were fixed at their last known values. Application of these percentages to the population estimates yielded our estimates of the foreign-born and native-born population.

Incidence rates were age-standardized to the 2000 U.S. standard million population. Incidence rate ratios (IRRs) were used to compare incidence rates between two groups, such as foreign-born and U.S.-born. Incidence rates were examined by year of diagnosis, and an age-adjusted annual percentage change (APC) statistic was calculated to evaluate secular trends in incidence rates. Rates based on fewer than 15 cases or a population less than 25,000 persons were considered unstable and not reported. Statistics were calculated using SEER*STAT software (Surveillance Research Program, National Cancer Institute SEER*Stat software (www.seer.cancer.gov/seerstat) version 6.3.5).

Tobacco consumption data on individual cases are not available in cancer registry data. Nevertheless, population prevalence data on cigarette smoking status among all Asians, Chinese, Filipinos, and Koreans in California were obtained from the California Health Interview Survey (CHIS) using *AskCHIS* Pro (<http://www.chis.ucla.edu>) combining data from the 2001 and 2003 CHIS. Information on smoking status among South Asians was obtained from the California Department of Health Services Tobacco Use Survey.¹⁵ Data were not available on the Japanese population through *AskCHIS*, and smoking estimates among Vietnamese were unstable and are not presented.

RESULTS

The incidence rate of NSCLC for California Asians between 1998 and 2003 was approximately half that of whites (Table 1). Among Asian subgroups, South Asians had the lowest (12.0 per 100,000 person-years), Vietnamese had the highest (39.2 per 100,000 person-years), and Japanese and Koreans had intermediate rates of NSCLC. The incidence rates of histologic subtypes of NSCLC among Asian subgroups followed similar patterns to the rates of all NSCLC. Six percent of NSCLC cases among Asians were BAC

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