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Lymphoid malignancies in US Asians: incidence rate differences by birthplace and acculturation

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Abstract

Background—Malignancies of the lymphoid cells, including non-Hodgkin lymphomas (NHLs), Hodgkin lymphoma (HL) and multiple myeloma (MM), occur at much lower rates in Asians than other racial/ethnic groups in the United States (US). It remains unclear whether these deficits are explained by genetic or environmental factors. To better understand environmental contributions, we examined incidence patterns of lymphoid malignancies among populations characterized by ethnicity, birthplace, and residential neighborhood socioeconomic status (SES) and ethnic enclave status.

Methods—We obtained data regarding all Asian patients diagnosed with lymphoid malignancies between 1988 and 2004 from the California Cancer Registry and neighborhood characteristics from US Census data.

Results—While incidence rates of most lymphoid malignancies were lower among Asian than white populations, only follicular lymphoma (FL), chronic lymphocytic leukemia/small lymphocytic lymphoma (CLL/SLL), and nodular sclerosis (NS) HL rates were statistically significantly lower among foreign-born than US-born Asians, with incidence rate ratios ranging from 0.34 to 0.87. Rates of CLL/SLL and NS HL were also lower among Asian women living in ethnic enclaves or lower-SES neighborhoods than those living elsewhere. Conclusions: These observations support strong roles of environmental factors in the causation of FL, CLL/SLL, and NS HL.

Impact—Studying specific lymphoid malignancies in US Asians may provide valuable insight towards understanding their environmental causes.

Keywords

lymphoid malignancies; Asians; immigration; environmental causes

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INTRODUCTION

Malignancies of the lymphoid cells, including non-Hodgkin lymphomas (NHLs), Hodgkin lymphoma (HL) and multiple myeloma (MM), are highly heterogeneous with respect to clinical features and patterns of occurrence (1). Despite this variation, United States (US) populations of Asian origin consistently have much lower incidence rates of lymphoid malignancies than populations of Caucasian or African origin (2). In our recent assessment of lymphoid malignancies in the US, overall incidence rates were substantially lower among Filipinos (67% of non-Hispanic white rate), South Asians (64%), Vietnamese (62%), Japanese (53%), Chinese (47%), and Koreans (33%) than among non-Hispanic whites (2). These striking differences may contain important clues as to genetic or environmental risk factors for these diseases, especially if incidence rates change with migration from low-risk (e.g., Asia) to higher-risk areas (e.g., US).

Unfortunately, cancer incidence rates according to measures of migration or acculturation cannot be readily calculated. Although patient birthplace is collected by cancer registries, it is missing in a biased manner for a substantial proportion of patients (3–6), and the birthplace-specific annual population counts needed for rate denominators are not readily available from governmental agencies. Measures of immigrant acculturation (e.g, years since migration, language used at home) are not collected at all by cancer registries. To surmount these challenges, we have developed a resource (7) incorporating cancer registry data from California and population data needed to calculate cancer incidence rates among US Asians by birthplace and two residential neighborhood measures of acculturation: socioeconomic status (SES) and ethnic enclave status. Using this resource, we examined variation in incidence rates of lymphoid malignancies among US Asians by these factors.

MATERIALS AND METHODS

Cancer data for rate numerators

From the California Cancer Registry (CCR), which comprises three of the National Cancer Institute's SEER program registries(8), we obtained information on all California residents diagnosed with a primary invasive lymphoid malignancy (International Classification of Disease for Oncology, 3rd Edition, (ICD-O-3) morphology codes 9590–9591, 9650–9655, 9661–9734, 9761, 9764, 9823, 9827–9837, 9940, 9948, and 9970) during the period 1 January 1988 through 31 December 2004. Using InterLymph Consortium guidelines (9, 10), we further classified lymphoid malignancies by histologic subtype into diffuse large B-cell lymphoma [DLBCL] (ICD-O-3 morphology codes 9680 and 9684, excluding those with code 9684 and a T-cell, NK-cell or null cell immunophenotype); follicular lymphoma [FL] (codes 9690, 9691, 9695, and 9698); chronic lymphocytic lymphoma/small lymphocytic leukemia [CLL/SLL] (codes 9823 and 9670); multiple myeloma [MM] (codes 9731–9734); classical HL (codes 9650–9655, 9661–9667) and its two most common subtypes, nodular sclerosis [NS] HL (codes 9663–9665, 9667) and mixed cellularity [MS] HL (code 9652); and T- or NK-cell NHL [TCL] (codes 9700–9719, 9729, 9827, 9831, 9834, 9837, and 9948 plus codes 9590, 9591, 9675, 9684, 9727, 9820, 9832, 9835, or 9970 and a T-cell or NK cell immunophenotype). Overall NHL was categorized as including codes 9590–9591, 9670–9729, 9761, 9764, 9820, 9823, 9827, 9831–9837, 9940, 9948, and 9970.

Incidence rates by birthplace

We included in these analyses 8,638 lymphoid malignancies (6,712 NHL, 526 NHL, and 1,410 MM) occurring in patients from the six Asian ethnic populations that together comprised 92% of all Asian and Pacific Islander patients with lymphoid malignancies in the CCR in the study period. Of these, 2,385 (28%) cases were Chinese, 1,246 (14%) were

Japanese, 2,913 (34%) were Filipino, 506 (6%) were Korean, 701 (8%) were South Asian (including Asian Indians, Pakistanis, Sri Lankans and Bangladeshis), and 887 (10%) were Vietnamese. Approximately 5% of patients were originally coded in the registry data as "Asian, not otherwise specified (NOS)"; for 55% of these patients, we were able to determine a more specific Asian ethnic designation based on birthplace and names (first, maiden, last) by applying the North American Association of Central Cancer Registries (NAACCR) Asian/Pacific Islander Identification Algorithm (11). We also included as a reference group 110,789 non-Hispanic white patients diagnosed with lymphoid malignancies (85,465 NHL, 8,967 HL, and 16,357 MM) during the same period.

Because patients in the cancer registry with unknown birthplace data are more likely to be US-born than those with available data (3–6), we developed a method based on patients' Social Security numbers (SSN) to more accurately classify patient immigrant status, as described previously (7). Briefly, we used: 1) registry-based birthplace data available for 81% of cases (73% from hospital medical records and 8% from death certificates); and 2) for the 19% of cases with unknown birthplace, statistical imputation of immigrant status using the patient's SSN. Comparing the age of SSN issue with self-reported birthplace in previously interviewed cancer patients (N=1,836) and based on maximization of the area under the receiver-operating characteristic curve and confirmation with logistic regression modeling, we considered cases who received an SSN before age 25 years US-born, and those who had received an SSN at or after age 25 years as foreign-born. This age cut-point resulted in 84% sensitivity and 80% specificity for assigning foreign-born status across the Asian populations. Fewer than 3% of cases with missing or invalid SSNs were assigned an immigrant status based on the ethnicity-sex-age birthplace distribution of the overall sample.

Incidence rates by neighborhood socioeconomic and ethnic enclave status

Using patient residential address and small area (census tract) information from the US Census, we classified neighborhood SES and ethnic enclave status for all Asian patients diagnosed between 1 January 1998 and 31 December 2002. We considered all Asians together as a single group because detailed ethnicity-specific population estimates are not available for census tracts, and chose the time period in question (i.e., within two years of the 2000 US Census) because census tract estimates are only available for decennial census years. Census tracts were geocoded from patient residential address at time of diagnosis. The 3% of eligible cases whose address could not be precisely geocoded to a census tract were randomly assigned to a census tract within their county of residence. We assigned neighborhood SES using a previously described index (12) that incorporates 2000 Census data on education, income, occupation, and housing costs. We categorized this measure by quintiles based on the distribution of the composite SES index across the state of California, then re-categorized into two groups because of small sample sizes in the quintiles: lower SES (quintiles 1, 2, and 3) or higher SES (quintiles 4 and 5). Because the CCR does not collect any individual-level information on patient SES, we could not assess neighborhood-level effects separately from those at the individual-level.

We defined a neighborhood ethnic enclave as a geographical unit that is relatively more concentrated in terms of its population and language (in this study specific to Asians) than other geographical units in California. To characterize residence in an ethnic enclave, we applied principal components analysis (PCA) (13) to selected census variables at the block group level, which was in turn averaged to the census tract level. The census variables included in the ethnic enclave index were: percent of Asian-language-speaking households that are linguistically isolated, percent of all Asian-language speakers who speak limited English, percent recent immigrants, and percent Asian. This index explained 63% of the variability in the data. Neighborhood ethnic enclave was classified into quintiles based on the distribution of the composite ethnic enclave index across the state of California, then re-

categorized into two groups because of small sample sizes in the quintiles: lower (quintiles 1, 2, and 3) or higher (quintiles 4 and 5) enclave status.

Population data for cancer rate denominators

From the 1990 and 2000 Census Summary File 3 (SF-3), we obtained population counts by sex, race/ethnicity, immigrant status, and five-year age group for the state of California. We also used data from the 20% Integrated Public-Use Microdata Sample of the Census to estimate age- and birthplace-specific population counts for the six Asian groups (14–17) by smoothing with a spline-based function(18). For intercensal years, we estimated the percent foreign-born using cohort component interpolation and extrapolation methods(19), adjusting estimates to the populations by age and year provided by the California Department of Finance for years 1988–1989 and by the US Census for years 1990–2004 due to data availability.

Statistical analysis

We used SEER*Stat software (20) to compute age-adjusted incidence rates (standardized to the 2000 US standard million population) and 95% confidence intervals (CIs). To comply with CCR regulations, we do not present case counts or rates based on fewer than 15 cases. For HL, we also calculated age-adjusted rates for persons ages 15–44 (N=159 males, 153 females), and 45 and above (N=110 males, 70 females), at diagnosis) because of strong previous evidence of etiologic differences between these groups (21). We calculated incidence rate ratios (IRRs) to compare incidence rates. Because of small case numbers, Asian ethnic groups were combined for analyses of NHL subtypes, MM, and HL, and analyses of HL rates jointly by SES and enclave could not be undertaken by age group. We could not perform joint analyses by birthplace and neighborhood SES or ethnic enclave status due to the lack of census-tract-level population data by birthplace. All analyses had the approval of the institutional review board of the Cancer Prevention Institute of California.

RESULTS

Among the 8,638 Asians diagnosed with a lymphoid malignancy in California in the years 1988 through 2004, the majority (75%) were foreign-born, although this proportion was much lower for Japanese (32%) (Table 1). Among histologic subtypes of NHL, the most common among Asians was DLBCL (*N*=2,345, 35% of all NHL), followed by TCL (N=721, 11%), FL (*N*=661, 10%), and CLL/SLL (*N*=560, 8%); by comparison, non-Hispanic whites had higher proportions of FL, CLL/SLL and a lower proportion of TCL. 1,410 Asians were diagnosed with MM and 516 with HL, including 322 (62%) with NS HL and 96 (19%) with MC HL.

Lymphoid malignancy incidence among Asians as compared to whites

For NHL overall, age-adjusted incidence rates for most Asian ethnic groups were substantially lower than those for non-Hispanic whites (Table 2). For example, the IRR among foreign-born Filipino males vs. white males was 0.70 (95% CI 0.65–0.75) and the corresponding IRR for females was 0.76 (95% CI 0.70–0.83); the IRR among foreign-born Chinese males vs. white males was 0.49 (95% CI 0.44–0.54) and the corresponding IRR among females was 0.50 (95% CI 0.45–0.55). The only groups for which rates were not significantly different from those of non-Hispanic whites were the relatively small populations of foreign-born Japanese men and US-born South-Asian and Vietnamese men and women.

For most specific lymphoid malignancy subtypes, incidence rates for both US- and foreign-born Asians were lower than those for non-Hispanic whites. The most marked deficits were observed for CLL/SLL (among males, IRR for foreign-born Asians vs. whites=0.22, 95% CI 0.18–0.25; among females, IRR=0.24, 95% CI 0.18–0.30) and NS HL (among males, IRR for foreign-born Asians vs. whites=0.25, 95% CI 0.13–0.37; among females, IRR=0.19, 95% CI 0.13–0.26). However, for TCL and DLBCL (in most ethnic groups), rates were comparable to those for non-Hispanic whites.

Lymphoid malignancy incidence among Asians by birthplace

For overall NHL, foreign-born Chinese, South Asian, and Vietnamese men and women had consistently lower incidence rates than their US-born counterparts (Table 2). By contrast, foreign-born Japanese men had incidence rates 71% higher than their US-born counterparts, whereas no birthplace difference was observed among Japanese women or Korean men or women.

For specific subtypes, Table 3 shows that FL incidence was consistently lower among foreign-born than US-born Asian men and women. For DLBCL, for which numbers of cases were adequate for examining rates for Chinese and Japanese, patterns were similar to those observed for overall NHL, with lower incidence rates for foreign-born vs. US-born Chinese men and women, in contrast to higher rates among foreign-born vs. US-born Japanese men. Among Japanese and other Asian (Filipina, South Asian, and Vietnamese) women, there were no significant differences in the incidence rate of DLBCL by birthplace. Incidence rates of TCL did not vary by birthplace among Asian men or women. For MM, rates were marginally higher (37%) among foreign-born than US-born Asian women, but comparable by birthplace in men.

For overall HL, rates among foreign-born Asians were approximately half those among US-born Asians. IRR patterns were similar for NS HL, but no nativity differences occurred in rates of MC HL. In data stratified by age, the protective effect of foreign birthplace was limited to young adults of both genders for HL overall; for NS HL, it was apparent for both younger and older females (IRR's of 0.34 (95% CI 0.23–0.50) for ages 15–44, and 0.32 (95% CI 0.14–0.80) for ages 45 and above).

Although we had limited statistical power for to assess rate changes over time stratified by birthplace, rates did not vary significantly between the periods 1988–1996 and 1997–2004 (data not shown). For overall NHL, rates increased significantly among US-born Chinese and Filipino men and foreign-born Korean men, but not among women of the same groups. IRRs comparing foreign- vs. US-born Asians were generally similar between 1988–1996 and 1997–2004, although for overall HL and NS HL, they were statistically significant only in the latter period (data not shown).

Lymphoid malignancies by neighborhood ethnic enclave and socioeconomic status

Among Asian men, ethnic enclave status did not impact the incidence rates of overall NHL, DLBCL, FL, CLL/SLL, TCL, MM, overall HL, NS HL, or MC HL (Table 4). By contrast, among Asian women, overall NHL, CLL/SLL, overall HL and MC HL were significantly less common in neighborhoods with higher ethnic enclave status. For HL, these patterns did not differ by age group for either gender. Asian men living in higher-SES neighborhoods had significantly elevated incidence rates of FL and NS HL (an effect limited to young adult men), but not of other lymphoma subtypes. Asian women in higher-SES neighborhoods had significantly higher incidence rates of FL, TCL and overall HL (apparent only for women over age 45 at diagnosis); marginally higher rates of NS HL and MC HL; but lower rates of CLL/SLL.

When we analyzed rates by neighborhood ethnic enclave status and SES jointly, we found that Asian men living in areas with both lower ethnic enclave status and higher SES had significantly higher incidence rates of overall NHL and FL, as well as a marginally higher incidence rate of DLBCL, than Asian men living in areas with both higher enclave status and lower SES (Table 4). For overall HL and NS HL, rates were marginally higher for Asian men living in neighborhoods of higher than lower SES irrespective of their ethnic enclave status. Compared to Asian women living in neighborhoods with both higher ethnic enclave status and lower SES, Asian women living in neighborhoods with lower ethnic enclave status and higher SES also had significantly elevated incidence rates of overall NHL, FL, overall HL and NS HL; elevations were particularly marked for the latter two (IRR=4.1, 95% CI 2.15–7.74, and 2.5, 95% CI 1.17–5.14, respectively). In addition, Asian women who resided in neighborhoods with both higher ethnic enclave status and higher SES had elevated incidence rates of FL, TCL, and overall HL but a lower rate of CLL/SLL. MM incidence rates did not vary by neighborhood enclave status and SES among Asian men or women.

DISCUSSION

A role for environmental exposures in cancer etiology can be inferred from changes in cancer incidence after migration from low- to high-risk areas. In a large population-based series of US Asians with lymphoid malignancies, we found that rates were substantially lower in foreign-born than US-born patients for certain lymphoma subtypes, specifically CLL/SLL, FL, and NS HL. Rates of CLL/SLL and NS HL were also significantly lower among Asian women living in ethnic enclaves or lower-SES neighborhoods, compared with rates of Asian women living in lower-enclave or higher-SES neighborhoods, respectively. For HL, the risks associated with higher-SES and lower-enclave neighborhoods were stronger in females than in males. For MM, incidence rates did not differ according to birthplace, ethnic enclave status, or neighborhood SES. We also confirmed that the incidence rates of most subtypes were substantially lower than rates in non-Hispanic white populations; for TCL and DLBCL—the two subtypes for which absolute incidence rates were most similar between Asians and non-Hispanic whites—we did not observe consistent differences in incidence according to birthplace or neighborhood characteristics.

There is little published information regarding the incidence patterns of lymphoid malignancy subtypes among Asians according to detailed ethnicity and birthplace. Our recent analysis based on SEER data documented lower incidence of lymphoid malignancies among six Asian ethnic groups compared with whites(2), but lacked the data to consider differences by birthplace. In SEER data, an assessment of NHL cases diagnosed in the period 1973–86 and classified according to the Working Formulation scheme also found reduced risk of FL in foreign-born compared with US-born Chinese and Japanese (but not Filipinos), with incidence rates 60–80% lower than rates in their US-born counterparts(22). However, in that analysis, the authors assumed that the SEER cases without birthplace information had randomly missing data. As we have shown that those with missing data are more likely to be US-born(5), this earlier analysis may have underestimated rate differences by birthplace, which may explain the difference in findings for CLL/SLL and HL. To our knowledge, ours is the first study to address lymphoid malignancy incidence patterns among US Asians according to neighborhood characteristics, although we did report previously that rates of young-adult HL were lower among Asian women (but not men) living in the lowest terciles of neighborhood SES in California(23). Our findings of lowered rates of CLL/SLL and NS HL among Asian women living in impoverished or ethnic enclave communities as compared to more affluent and presumably more acculturated communities further support the notion that the causation of these particular lymphoid malignancy subtypes involves environmental exposures more common in westernized environments.

Differences in cancer incidence rates between Asians who immigrate to the US (and their descendents) and those who remain in Asia have long been considered strong evidence of environmental influences on carcinogenesis, although it is possible that there are also genetic differences among persons who are healthy enough to emigrate. For breast cancer, incidence rates among Chinese and Filipina women born in the US are nearly twice those of women living in Asia, and these differences are increasingly thought to relate to reproductive and dietary changes associated with westernized lifestyle(7, 24). For NS HL, exposures of interest include correlates of the childhood social environment(25) (e.g., family size, household crowding) and measures of microbial burden or other immunologically relevant environmental exposures (e.g., age at diagnosis with mononucleosis)(26), particularly in early life (21, 25, 27–33). Childhood environment has not been consistently associated with risk of FL or CLL/SLL(34–36), although a recent pooled analysis including over 13,500 NHL cases did report for FL significantly positive associations with both birth order and sibship size(36). However, risk of both FL and CLL/SLL has been inversely associated with atopic disease(37), which could be associated in turn with early-life microbial exposures. It is uncertain if chronic infection with hepatitis viruses, linked to doubled risks of NHL(38, 39) and endemic in Asia(40, 41), are relevant to the observed rate patterns. Although US-born Asians have lower rates of chronic infection with hepatitis B and C viruses than their foreign-born counterparts in the US and Asia(40, 42), the associations of viral hepatitis with risk of specific NHL subtypes (e.g., DLBCL) do not correspond the observed incidence rate differences by birthplace in our study(43).

The stronger effects of birthplace and neighborhood characteristics for CLL/SLL and HL observed in females than males could, in part, reflect socially determined differences in exposure opportunities (such as those involving children) and biologically determined differences in immune response to exposures(23). For HL, the gender difference in the effect of nativity may result from protection in low-acculturation women afforded by both early exposure to infection and higher parity or lactation, as hormonal exposures through pregnancy and breast-feeding may interact with childhood exposures to affect risk of HL(44).

For HL, the varying impact of birthplace by age group is consistent with prior evidence of differing pathogenesis of HL by age (21). It also is relevant to the differential effect of birthplace on incidence of the NS and MC subtypes, given that young adult HL is predominantly of the NS subtype. Further, subtype differences in birthplace associations may reflect etiologic differences in immune control and age at infection of Epstein-Barr virus (EBV), as EBV is more commonly found in tumors of the MC than NS type (45, 46) and of Asians than whites (47).

Dietary patterns and energy balance/obesity, which also vary by birthplace among US Asians (48), may also be associated with risk of certain lymphoid malignancies (49–52), and therefore represent important areas for future study in Asian immigrant populations. For MM, our observation of substantially lowered rates among Asians as compared to non-Hispanic whites, but no difference according to birthplace or neighborhood characteristics, suggests a more important role for genetic susceptibility and less of an influence of environmental exposures that change with acculturation. In support of this hypothesis, MM risk has been associated with polymorphisms in genes thought to influence innate immunity and immunoregulatory processes (53, 54).

By using over 16 years of SEER data from California, we were able to capitalize on the relatively large size of the Asian population in this state and to draw conclusions based on the representativeness of these high-quality, population-based data. We consider the ethnic and birthplace classifications used here to have low probabilities of misclassification or bias.

Specific Asian ethnic group was classified directly from registry records or, for those without specific registry information on ethnicity, from applying a validated ethnicity classification algorithm. With this approach, a small proportion (<3%) of patients was excluded from these analyses because of missing ethnic classification. Furthermore, cancer registry classification of specific Asian ethnicity shows good agreement with self-reported information (55). For cases for whom birthplace information was reported to the registry (the vast majority), we have also demonstrated that this classification shows excellent agreement in comparison with self-reported birthplace (4, 5); for the remaining cases, we applied a validated birthplace classification algorithm with good sensitivity and specificity.

Despite these important strengths, our results also may be subject to some limitations. First, we had limited statistical power to analyze certain subgroups, such as specific Asian ethnic groups and uncommon lymphoid malignancies. Second, the heterogeneity in the complex pathologic methods required to diagnose and classify lymphoma cases may have resulted in misclassification of some cases by subtype. Our prior comparisons of cancer registry ICD-O-3 classifications to those obtained from uniform re-review of pathologic specimens suggest a high degree of reliability for the diagnosis of overall NHL and HL(56) and for particular subtype classifications including FL (89%), SLL (79%), DLBCL (90%), and NS HL (95%), but more moderate reliability for rarer subtypes(57, 58). In addition, cancer registry data lack detail regarding certain histopathologic characterizations (e.g., t(14;18) translocations for FL, and EBV tumor-cell status for HL), as well as information regarding parental race/ethnicity, individual-level education and other measures of SES, medical history, age at immigration, duration of immigration and other risk factors that could be relevant to our observed incidence rate differentials. Lastly, these data cannot speak to the independent or joint influence of genetic factors in modifying risk of FL and CLL/SLL across populations. Recent genomewide association studies found genetic variants that influence risk for FL(59) and SLL/CLL(60) and the absolute difference between rates in US-born Asians and whites does not rule out a role for genetic predisposition to FL and CLL/SLL. Regardless, our results suggest that environmental exposures have greater influence than genes on the variation in incidence rates by ethnicity and nativity.

The markedly lowered rates of lymphoid malignancies among Asians relative to other racial/ethnic groups in the US and among foreign-born Asians relative to US-born Asians have suggested some kind of protection from lymphomagenic processes, but it has been unclear whether this protection relates to genetic or environmental differences. Our data suggest a clear pattern of increased risk of FL, CLL/SLL and HL in Asians according to US birthplace and neighborhood acculturation indicators, and thereby point to a strong influence of environmental factors that change with immigration and acculturation to a westernized lifestyle. Future studies of FL, CLL/SLL and HL designed to collect a wide array of environmental exposure information (and implicated genetic variants of risk) are warranted among Asian immigrant populations in the US and other westernized countries, as they may identify heretofore unrecognized and modifiable causes of these malignancies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Demographic and disease characteristics of Asian and non-Hispanic White patients diagnosed with lymphoid malignancies, California, 1988–2004

Characteristic	Chinese		Japanese		Filipino		Korean		South Asian		Vietnamese		All Asian		Non- Hispanic White	
Age at diagnosis (years)																
0–29	272	11%	58	5%	285	10%	79	16%	131	19%	165	19%	990	11%	7,455	7%
30–49	381	16%	141	11%	467	16%	97	19%	147	21%	195	22%	1,428	17%	17,158	15%
50–69	801	34%	433	35%	1,009	35%	173	34%	264	38%	299	34%	2,979	34%	36,730	33%
70+	931	39%	614	49%	1,152	40%	157	31%	159	23%	228	26%	3,241	38%	49,446	45%
Sex																
Male	1,359	57%	642	52%	1,572	54%	278	55%	419	60%	485	55%	4,755	55%	62,674	57%
Female	1,026	*43%*	604	48%	1,341	46%	228	45%	282	40%	402	45%	3,883	45%	48,115	43%
Nativity																
US-born	620	26%	850	68%	355	12%	72	14%	134	19%	112	13%	2,143	25%	---	---
Foreign-born	1,765	74%	396	32%	2,558	88%	434	86%	567	81%	775	87%	6,495	75%	---	---
Tumor histology																
Diffuse large B-cell lymphoma	621	26%	366	29%	845	29%	131	26%	118	17%	264	30%	2,345	27%	21,920	20%
Follicular lymphoma	225	9%	142	11%	147	5%	29	6%	51	7%	67	8%	661	8%	12,027	11%
Chronic lymphocytic leukemia/small lymphocytic lymphoma	183	8%	82	7%	156	5%	23	5%	69	10%	47	5%	560	6%	18,973	17%
T-cell lymphoma	207	9%	88	7%	212	7%	58	11%	65	9%	91	10%	721	8%	5,454	5%
Other non-Hodgkin lymphoma	682	29%	352	28%	789	27%	159	31%	192	27%	251	28%	2,425	28%	27,091	24%
Multiple myeloma	342	14%	170	14%	575	20%	85	17%	123	18%	115	13%	1,410	16%	16,357	15%
Overall Hodgkin lymphoma	125	5%	46	4%	189	6%	21	4%	83	12%	52	6%	516	6%	8,967	8%
Nodular sclerosis Hodgkin lymphoma	76	3%	27	2%	122	4%	13	3%	51	7%	33	4%	322	4%	5,808	5%
Mixed cellularity Hodgkin lymphoma	28	1%	8	1%	31	1%	2	0%	16	2%	11	1%	96	1%	1,532	1%
Other classical Hodgkin lymphoma	21	1%	11	1%	36	1%	6	1%	16	2%	8	1%	98	1%	1,627	1%
Total	2,385		1,246		2,913		506		701		887		8,638		110,789	

Table 2

Age-adjusted incidence rates (per 100,000 person-years) of overall non-Hodgkin lymphoma and incidence rate ratios (IRRs) by nativity among Asians and non-Hispanic whites, California, 1988–2004

Asian ethnic group	Nativity	Males				
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
Chinese	US-born	320	30.6	(26.7–34.8)	1.00	reference
	Foreign-born	775	16.9	(15.2–18.7)	**0.55**	**(0.47–0.65)**
Japanese	US-born	396	18.1	(16.3–20.1)	1.00	reference
	Foreign-born	130	30.9	(25.1–37.6)	**1.71**	**(1.35–2.14)**
Filipino	US-born	156	23.3	(18.0–29.6)	1.00	reference
	Foreign-born	1,026	24.1	(22.3–26.0)	1.03	(0.8–1.36)
Korean	US-born	36	16.8	(7.0–32.4)	1.00	reference
	Foreign-born	188	12.7	(10.7–15.1)	0.76	(0.38–1.84)
South Asian	US-born	58	46.9	(27.7–73.1)	1.00	reference
	Foreign-born	244	20.1	(17.1–23.4)	**0.43**	**(0.27–0.74)**
Vietnamese	US-born	50	66.3	(36.1–109.5)	1.00	reference
	Foreign-born	350	19.3	(16.9–22.0)	**0.29**	**(0.17–0.54)**
Non-Hispanic White		48,816	34.5	(34.2–34.8)	---	---

Asian ethnic group	Nativity	Females				
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
Chinese	US-born	195	15.5	(13.1–18.1)	1.00	reference
	Foreign-born	628	10.4	(9.5–11.4)	**0.67**	**(0.56–0.81)**
Japanese	US-born	298	13	(11.5–14.7)	1.00	reference
	Foreign-born	206	14	(12–16.4)	1.08	(0.88–1.32)
Filipino	US-born	106	13.5	(9.8–18.1)	1.00	reference
	Foreign-born	861	15.8	(14.3–17.3)	1.17	(0.86–1.62)
Korean	US-born	25	6.3	(2.5–13.1)	1.00	reference
	Foreign-born	151	7.2	(5.9–8.6)	1.14	(0.53–2.98)
South Asian	US-born	37	35	(18.6–58.4)	1.00	reference
	Foreign-born	156	14.3	(11.8–17.2)	**0.41**	**(0.24–0.79)**
Vietnamese	US-born	39	34.9	(17.3–62.7)	1.00	reference

Asian ethnic group	Nativity	Females					
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
	Foreign-born	281	14.8	(13–16.9)	**0.42**	**(0.23–0.87)**
Non-Hispanic White		36,649	20.7	(20.5–20.9)	---	---

Table 3

Age-adjusted incidence rates (per 100,000 person-years) of non-Hodgkin lymphoma histologic subtypes, multiple myeloma, Hodgkin lymphoma subtypes, and incidence rate ratios (IRRs) by nativity among Asians and non-Hispanic whites, California, 1988–2004.

Lymphoid malignancy	Asian ethnic group	Nativity	Males				
			Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
Diffuse large B-cell lymphoma							
	All	US-born	314	8.5	(7.5–9.5)	1.00	reference
		Foreign-born	961	6.5	(6.1–7.0)	**0.77**	**(0.67–0.88)**
	Chinese	US-born	96	10.9	(8.6–13.6)	1.00	reference
		Foreign-born	257	4.7	(4.1–5.4)	**0.43**	**(0.33–0.57)**
	Japanese	US-born	149	6.7	(5.6–8.0)	1.00	reference
		Foreign-born	49	11.5	(8.0–15.7)	**1.71**	**(1.14–2.46)**
	Other Asian	US-born	69	8.8	(6.3–11.8)	1.00	reference
		Foreign-born	655	7.4	(6.8–8.1)	0.85	(0.62–1.20)
	Non-Hispanic White		12,636	8.8	(8.7–9.0)	---	---
Follicular lymphoma							
	All	US-born	96	2.7	(2.1–3.3)	1.00	reference
		Foreign-born	244	1.5	(1.3–1.7)	**0.57**	**(0.44–0.73)**
	Non-Hispanic White		5,981	4.1	(4.0–4.2)	---	---
Chronic lymphocytic leukemia/small lymphocytic lymphoma							
	All	US-born	81	2.4	(1.9–2.9)	1.00	reference
		Foreign-born	249	1.7	(1.5–1.9)	**0.72**	**(0.56–0.95)**
	Non-Hispanic White		11,094	7.9	(7.8–8.1)	---	---
T-cell lymphoma							
	All	US-born	122	2.2	(1.8–2.7)	1.00	reference
		Foreign-born	305	2.0	(1.8–2.3)	0.91	(0.71–1.18)
	Non-Hispanic White		3,348	2.4	(2.3–2.5)	---	---
Multiple myeloma							
	All	US-born	128	3.8	(3.2–4.5)	1.00	reference
		Foreign-born	614	4.3	(4.0–4.7)	1.14	(0.94–1.41)

Lymphoid malignancy	Asian ethnic group	Nativity	Males				
			Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
	Non-Hispanic White		8,929	6.4	(6.2–6.5)	---	---
All Hodgkin lymphoma							
	All	US-born	105	1.8	(1.4–2.2)	1.00	Reference
		Foreign-born	179	1.1	(0.9–1.2)	**0.60**	**(0.46–0.80)**
	Non-Hispanic White		4,929	3.4	(3.3–3.5)	---	---
Hodgkin lymphoma, Age <45 years							
	All	US-born	82	1.7	(1.3–2.2)	1.00	Reference
		Foreign-born	92	0.7	(0.6–1.0)	**0.43**	**(0.30–0.63)**
	Non-Hispanic White		3,010	3.2	(3.1–3.3)	---	---
Hodgkin lymphoma, Age 45+ years							
	All	US-born	23	1.8	(1.1–2.7)	1.00	Reference
		Foreign-born	87	1.6	(1.3–2.0)	0.90	(0.55–1.51)
	Non-Hispanic White		1,919	3.8	(3.7–4.0)	---	---
Hodgkin lymphoma, Nodular sclerosis							
	All	US-born	64	1.0	(0.8–1.4)	1.00	reference
		Foreign-born	92	0.5	(0.4–0.7)	**0.53**	**(0.36–0.79)**
	Non-Hispanic White		2,900	2.0	(1.9–2.1)	---	---
Hodgkin lymphoma, Mixed cellularity							
	All	US-born	15	0.3	(0.2–0.5)	1.00	reference
		Foreign-born	47	0.3	(0.2–0.4)	0.90	(0.48–1.86)
	Non-Hispanic White		1,001	0.7	(0.7–0.7)	---	---

Lymphoid malignancy	Asian ethnic group	Nativity	Females				
			Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
Diffuse large B-cell lymphoma							
	All	US-born	198	4.6	(4.0–5.4)	1.00	reference
		Foreign-born	872	4.7	(4.4–5.0)	1.01	(0.86–1.19)
	Chinese	US-born	49	4.5	(3.3–6.0)	1.00	reference

Lymphoid malignancy	Asian ethnic group	Nativity	Females				
			Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
		Foreign-born	219	3.6	(3.1–4.1)	0.80	(0.58–1.14)
	Japanese	US-born	107	4.4	(3.5–5.3)	1.00	reference
		Foreign-born	61	4.1	(3.0–5.4)	0.94	(0.65–1.34)
	Other Asian	US-born	42	5.1	(3.3–7.4)	1.00	reference
		Foreign-born	592	5.5	(5.0–5.9)	1.07	(0.73–1.66)
	Non-Hispanic White		9,284	5.2	(5.1–5.3)	---	---
Follicular lymphoma							
	All	US-born	77	2.0	(1.5–2.5)	1.00	reference
		Foreign-born	244	1.2	(1.0–1.4)	**0.61**	**(0.47–0.81)**
	Non-Hispanic White		6,046	3.5	(3.4–3.6)	---	---
Chronic lymphocytic leukemia/small lymphocytic lymphoma							
	All	US-born	44	1.2	(0.8–1.6)	1.00	reference
		Foreign-born	186	1.0	(0.9–1.2)	**0.87**	**(0.56–0.95)**
	Non-Hispanic White		7,879	4.2	(4.1–4.3)	---	---
T-cell lymphoma							
	All	US-born	77	1.5	(1.1–1.9)	1.00	reference
		Foreign-born	217	1.1	(1.0–1.3)	0.75	(0.56–1.03)
	Non-Hispanic White		2,106	1.3	(1.2–1.3)	---	---
Multiple myeloma							
	All	US-born	87	2.3	(1.8–2.9)	1.00	reference
		Foreign-born	581	3.2	(2.9–3.5)	**1.37**	**(1.09–1.75)**
	Non-Hispanic White		7,428	4.0	(3.9–4.1)	---	---
All Hodgkin lymphoma							
	All	US-born	107	1.6	(1.2–1.9)	1.00	Reference
		Foreign-born	125	0.6	(0.5–0.7)	**0.38**	**(0.28–0.52)**
	Non-Hispanic White		4,038	2.8	(2.7–2.8)	---	---
Hodgkin lymphoma, Age <45 years							
	All	US-born	91	1.7	(1.3–2.1)	1.00	Reference

Lymphoid malignancy	Asian ethnic group	Nativity	Females				
			Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
		Foreign-born	71	0.5	(0.4–0.7)	**0.29**	**(0.20–0.43)**
	Non-Hispanic White		2,600	2.9	(2.8–3.1)	---	---
Hodgkin lymphoma, Age 45+ years							
	All	US-born	16	1.3	(0.7–2.1)	1.00	Reference
		Foreign-born	54	0.8	(0.6–1.0)	0.60	(0.34–1.14)
	Non-Hispanic White		1,438	2.4	(2.3–2.5)	---	---
Hodgkin lymphoma, Nodular sclerosis							
	All	US-born	83	1.1	(0.9–1.4)	1.00	reference
		Foreign-born	83	0.4	(0.3–0.5)	**0.34**	**(0.24–0.48)**
	Non-Hispanic White		2,908	2.1	(2.0–2.1)	---	---
Hodgkin lymphoma, Mixed cellularity							
	All	US-born	11	---	---	1.00	reference
		Foreign-born	23	0.1	(0.1–0.2)	0.64	(0.28–1.67)
	Non-Hispanic White		531	0.3	(0.3–0.4)	---	---

* Standardized to the 2000 U.S. population age standard. Incidence rates with numerator <15 are not computed.

CI: Confidence interval

Table 4

Age-adjusted incidence rates (per 100,000 person-years) of non-Hodgkin lymphoma and histologic subtypes, multiple myeloma, and Hodgkin lymphoma and histologic subtypes, and incidence rate ratios (IRRs) by neighborhood immigrant enclave status and socioeconomic status (SES) among Asians, California, 1998–2002

Lymphoid malignancy	Neighborhood characteristic	Males				
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
Overall non-Hodgkin lymphoma						
	Low enclave status	343	22.6	(20.2–25.2)	1.00	reference
	High enclave status	1,139	20.6	(19.4–21.9)	0.91	(0.80–1.04)
	Low SES	715	20.2	(18.7–21.7)	1.00	reference
	High SES	767	22.1	(20.4–23.8)	1.09	(0.98–1.22)
	High enclave status/low SES	546	19.9	(18.2–21.7)	1.00	reference
	Low enclave status/low SES	169	20.7	(17.6–24.2)	1.04	(0.87–1.24)
	High enclave status/high SES	593	21.4	(19.5–23.3)	1.07	(0.95–1.21)
	Low enclave status/high SES	174	24.8	(21.0–29.0)	**1.24**	**(1.03–1.49)**
Diffuse large B-cell lymphoma						
	Low enclave status	112	7.6	(6.2–9.2)	1.00	reference
	High enclave status	374	7.0	(6.2–7.7)	0.92	(0.74–1.16)
	Low SES	235	6.7	(5.9–7.7)	1.00	reference
	High SES	251	7.6	(6.6–8.6)	1.12	(0.93–1.36)
	High enclave status/low SES	184	6.8	(5.9–7.9)	1.00	reference
	Low enclave status/low SES	51	6.4	(4.7–8.5)	0.94	(0.67–1.29)
	High enclave status/high SES	190	7.2	(6.1–8.4)	1.05	(0.85–1.31)
	Low enclave status/high SES	61	9.0	(6.8–11.7)	1.32	(0.95–1.79)
Follicular lymphoma						
	Low enclave status	36	2.3	(1.6–3.2)	1.00	reference
	High enclave status	106	1.8	(1.5–2.2)	0.81	(0.55–1.24)
	Low SES	57	1.5	(1.2–2.0)	1.00	reference
	High SES	85	2.4	(1.9–2.9)	**1.52**	**(1.06–2.19)**
	High enclave status/low SES	48	1.7	(1.2–2.2)	1.00	reference
	Low enclave status/low SES	9	---		0.62	(0.27–1.29)

Lymphoid malignancy	Neighborhood characteristic	Males				
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
	High enclave status/high SES	58	2.0	(1.5–2.6)	1.19	(0.79–1.81)
	Low enclave status/high SES	27	3.7	(2.4–5.5)	**2.19**	**(1.29–3.64)**
Chronic lymphocytic leukemia/small lymphocytic lymphoma						
	Low enclave status	32	2.1	(1.4–3.1)	1.00	reference
	High enclave status	102	1.9	(1.6–2.4)	0.91	(0.60–1.42)
	Low SES	64	1.8	(1.4–2.3)	1.00	reference
	High SES	70	2.2	(1.7–2.8)	1.20	(0.83–1.73)
	High enclave status/low SES	46	1.7	(1.2–2.3)	1.00	reference
	Low enclave status/low SES	18	2.2	(1.3–3.5)	1.30	(0.70–2.29)
	High enclave status/high SES	56	2.2	(1.6–2.9)	1.30	(0.85–1.99)
	Low enclave status/high SES	14	---		1.20	(0.58–2.27)
T-cell lymphoma						
	Low enclave status	37	2.2	(1.5–3.1)	1.00	reference
	High enclave status	148	2.5	(2.1–2.9)	1.13	(0.77–1.71)
	Low SES	87	2.3	(1.8–2.8)	1.00	reference
	High SES	98	2.6	(2.1–3.2)	1.13	(0.82–1.54)
	High enclave status/low SES	72	2.4	(1.9–3.1)	1.00	reference
	Low enclave status/low SES	15	1.7	(0.9–2.8)	0.69	(0.36–1.23)
	High enclave status/high SES	76	2.5	(2.0–3.2)	1.03	(0.73–1.47)
	Low enclave status/high SES	22	2.8	(1.7–4.4)	1.14	(0.65, 1.92)
Multiple myeloma						
	Low enclave status	62	4.4	(3.3–5.7)	1.00	reference
	High enclave status	202	3.8	(3.3–4.4)	0.87	(0.65–1.19)
	Low SES	137	4.0	(3.3–4.7)	1.00	reference
	High SES	127	3.9	(3.2–4.6)	0.97	(0.75–1.25)
	High enclave status/low SES	101	3.8	(3.1–4.6)	1.00	reference
	Low enclave status/low SES	36	4.8	(3.3–6.6)	1.26	(0.83–1.86)
	High enclave status/high SES	101	3.9	(3.1–4.7)	1.02	(0.76–1.37)
	Low enclave status/high SES	26	3.9	(2.5–5.8)	1.04	(0.64–1.63)

Cancer Epidemiol Biomarkers Prev. Author manuscript; available in PMC 2012 June 1.

Lymphoid malignancy	Neighborhood characteristic	Males				
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
Overall Hodgkin lymphoma						
	Low enclave status	27	1.5	(1.0–2.2)	1.00	reference
	High enclave status	84	1.2	(0.9–1.5)	0.79	(0.50–1.28)
	Low SES	42	1.0	(0.7–1.4)	1.00	reference
	High SES	69	1.5	(1.1–1.9)	1.46	(0.98–2.23)
Hodgkin lymphoma, Age<45 years						
	Low enclave status	12	---	---	1.00	reference
	High enclave status	56	1.1	(0.8–1.4)	1.19	(0.63–2.45)
	Low SES	21	0.7	(0.4–1.0))	1.00	reference
	High SES	47	1.4	(1.0–1.9)	**2.12**	**(1.24–3.75)**
Hodgkin lymphoma, Age 45+ years						
	Low enclave status	15	2.6	(1.4–4.3)	1.00	reference
	High enclave status	28	1.4	(0.9–2.0)	0.53	(0.27–1.09)
	Low SES	21	1.6	(1.0–2.5)	1.00	reference
	High SES	22	1.6	(1.0–2.5)	0.96	(0.50–1.89)
Hodgkin lymphoma, Nodular sclerosis						
	Low enclave status	14	---	---	1.00	reference
	High enclave status	49	0.7	(0.5–0.9)	0.92	(0.49–1.83)
	Low SES	20	0.4	(0.3–0.7)	1.00	reference
	High SES	43	0.9	(0.6–1.2)	**2.01**	**(1.14–3.66)**
Hodgkin lymphoma, Mixed cellularity						
	Low enclave status	6	---	---	1.00	reference
	High enclave status	16	0.2	(0.1–0.4)	0.67	(0.24–2.13)
	Low SES	12	---	---	1.00	reference
	High SES	10	---	---	0.73	(0.27–1.90)

Lymphoid malignancy	Neighborhood characteristic	Females				
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
Overall non-Hodgkin lymphoma						
	Low enclave status	307	16.0	(14.2–17.9)	1.00	reference
	High enclave status	921	13.7	(12.8–14.7)	**0.86**	**(0.75–0.98)**
	Low SES	604	13.8	(12.7–14.9)	1.00	reference
	High SES	624	14.7	(13.5–15.9)	1.06	(0.95–1.20)
	High enclave status/low SES	442	13.2	(12.0–14.5)	1.00	reference
	Low enclave status/low SES	162	15.7	(13.3–18.3)	1.18	(0.98–1.43)
	High enclave status/high SES	479	14.2	(12.9–15.6)	1.08	(0.94–1.23)
	Low enclave status/high SES	145	16.5	(13.8–19.5)	**1.24**	**(1.02–1.51)**
Diffuse large B-cell lymphoma						
	Low enclave status	108	5.7	(4.7–6.9)	1.00	reference
	High enclave status	343	5.2	(4.7–5.8)	0.91	(0.73–1.15)
	Low SES	235	5.3	(4.7–6.1)	1.00	reference
	High SES	216	5.3	(4.6–6.1)	1.00	(0.82–1.21)
	High enclave status/low SES	169	5.0	(4.3–5.8)	1.00	reference
	Low enclave status/low SES	66	6.4	(4.9–8.2)	1.28	(0.94–1.71)
	High enclave status/high SES	174	5.5	(4.7–6.4)	1.09	(0.87–1.36)
	Low enclave status/high SES	42	4.9	(3.5–6.7)	0.98	(0.67–1.39)
Follicular lymphoma						
	Low enclave status	32	1.6	(1.1–2.2)	1.00	reference
	High enclave status	88	1.2	(1.0–1.5)	0.80	(0.53–1.25)
	Low SES	44	1.0	(0.7–1.3)	1.00	reference
	High SES	76	1.7	(1.3–2.1)	**1.71**	**(1.16–2.55)**
	High enclave status/low SES	31	0.9	(0.6–1.3)	1.00	reference
	Low enclave status/low SES	13	---		1.26	(0.60–2.50)
	High enclave status/high SES	57	1.6	(1.2–2.0)	**1.71**	**(1.08–2.76)**
	Low enclave status/high SES	19	2.1	(1.2–3.3)	**2.25**	**(1.17–4.18)**
Chronic lymphocytic leukemia/small lymphocytic lymphoma						
	Low enclave status	29	1.7	(1.1–2.4)	1.00	reference
	High enclave status	60	1.0	(0.7–1.2)	**0.58**	**(0.36–0.95)**

Lymphoid malignancy	Neighborhood characteristic	Females				
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
	Low SES	59	1.4	(1.1–1.8)	1.00	reference
	High SES	30	0.8	(0.5–1.1)	**0.53**	**(0.33–0.85)**
	High enclave status/low SES	39	1.2	(0.9–1.7)	1.00	reference
	Low enclave status/low SES	20	2.1	(1.3–3.3)	1.76	(0.95–3.11)
	High enclave status/high SES	21	0.7	(0.4–1.0)	**0.55**	**(0.30–0.96)**
	Low enclave status/high SES	9	---		0.91	(0.37–1.94)
T-cell lymphoma						
	Low enclave status	25	1.2	(0.8–1.8)	1.00	reference
	High enclave status	104	1.4	(1.2–1.8)	1.22	(0.77–2.00)
	Low SES	52	1.1	(0.8–1.5)	1.00	reference
	High SES	77	1.7	(1.3–2.1)	**1.45**	**(1.00–2.12)**
	High enclave status/low SES	40	1.2	(0.8–1.6)	1.00	reference
	Low enclave status/low SES	12	1.1	(0.6–1.9)	0.95	(0.44–1.87)
	High enclave status/high SES	64	1.7	(1.3–2.2)	1.50	(0.99–2.30)
	Low enclave status/high SES	**13**	---		1.18	(0.56–2.29)
Multiple myeloma						
	Low enclave status	63	3.2	(2.5–4.1)	1.00	reference
	High enclave status	211	3.3	(2.9–3.8)	1.03	(0.77–1.40)
	Low SES	150	3.5	(2.9–4.1)	1.00	reference
	High SES	125	3.2	(2.6–3.8)	0.92	(0.72–1.18)
	High enclave status/low SES	112	3.4	(2.8–4.1)	1.00	reference
	Low enclave status/low SES	38	3.6	(2.5–5.0)	1.06	(0.71–1.56)
	High enclave status/high SES	99	3.3	(2.6–4.0)	0.95	(0.72–1.26)
	Low enclave status/high SES	25	2.7	(1.7–4.1)	0.80	(0.49–1.26)
Overall Hodgkin lymphoma						
	Low enclave status	41	2.0	(1.4–2.7)	1.00	reference
	High enclave status	68	0.9	(0.7–1.1)	**0.44**	**(0.29–0.67)**
	Low SES	40	0.8	(0.6–1.1)	1.00	reference
	High SES	69	1.4	(1.1–1.8)	**1.71**	**(1.13–2.62)**

Lymphoid malignancy	Neighborhood characteristic	Females				
		Cases (*N*)	Incidence rate*	95% CI	IRR	95% CI
Hodgkin lymphoma, Age<45 years						
	Low enclave status	28	1.9	(1.2–2.7)	1.00	reference
	High enclave status	50	0.9	(0.7–1.2)	**0.50**	**(0.30–0.82)**
	Low SES	32	1.0	(0.7–1.4)	1.00	reference
	High SES	46	1.3	(1.0–1.8))	1.37	(0.84–2.23)
Hodgkin lymphoma, Age 45+ years						
	Low enclave status	13	---	---	1.00	reference
	High enclave status	18	0.8	(0.4–1.2)	**0.35**	**(0.12–0.79)**
	Low SES	8	---	---	1.00	reference
	High SES	23	1.6	(1.0–2.4))	**2.83**	**(1.20–7.46)**
Hodgkin lymphoma, Nodular sclerosis						
	Low enclave status	24	1.1	(0.7–1.7)	1.00	reference
	High enclave status	56	0.7	(0.5–0.9)	0.63	(0.38–1.08)
	Low SES	31	0.6	(0.4–0.9)	1.00	reference
	High SES	49	0.9	(0.7–1.3)	1.51	(0.93–2.48)
Hodgkin lymphoma, Mixed cellularity						
	Low enclave status	9	---	---	1.00	reference
	High enclave status	5	---	---	**0.16**	**(0.04–0.55)**
	Low SES	<5	---	---	1.00	reference
	High SES	11	---	---	3.76	(0.98–21.08)

*Standardized to the 2000 U.S. population age standard. Incidence rates with numerator <15 are not computed.

CI: Confidence interval