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Neighborhood disadvantage and dementia incidence in a cohort of Asian American and non-Latino white older adults in Northern California

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Abstract

INTRODUCTION: Some evidence suggests that neighborhood socioeconomic disadvantage is associated with dementia-related outcomes. However, prior research is predominantly among non-Latino whites.

METHODS: We evaluated the association between neighborhood disadvantage (Area Deprivation Index [ADI]) and dementia incidence in Asian American (n=18,103) and non-Latino white (n=149,385) members of a Northern California integrated healthcare delivery system aged 60–89 at baseline. Race/ethnicity-specific Cox proportional hazards models adjusted for individual-level age, sex, socioeconomic measures, and block group population density estimated hazard ratios (HRs) for dementia.

RESULTS: Among non-Latino whites, ADI was associated with dementia incidence (most vs. least disadvantaged ADI quintile HR=1.09, 95% CI=1.02–1.15). Among Asian Americans,

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associations were close to null (e.g., most vs. least disadvantaged ADI quintile HR=1.01, 95% CI=0.85–1.21).

DISCUSSION: ADI was associated with dementia incidence among non-Latino whites but not Asian Americans. Understanding the potentially different mechanisms driving dementia incidence in these groups could inform dementia prevention efforts.

Keywords

racial/ethnic disparities; dementia; social determinants; incidence; neighborhood disadvantage

Introduction

Neighborhood context has been linked with morbidity and mortality throughout the lifecourse, [1–4] and a growing literature reports an association between high neighborhood disadvantage and lower cognitive test scores among older adults [5–8]. Findings from studies examining associations of neighborhood disadvantage with dementia incidence, rate of cognitive decline, and markers of Alzheimer's pathology are mixed: most indicate an association between lower neighborhood disadvantage and better cognitive and brain health [9–13], while other studies suggest no association [14,15].

Most studies evaluating neighborhood context and dementia-related outcomes overwhelmingly comprise non-Latino white participants. Emerging evidence shows racial/ethnic differences in magnitude of associations between risk and protective factors and late-life cognitive and brain health [16–18]. For example, Avila et al. found that the contribution of education to cognitive reserve differed among Black and Caribbean Hispanic versus white older adults in Northern Manhattan [19]. Characterizing determinants of dementia in Asian Americans may help explain mechanisms leading to lower dementia incidence in Asian Americans than other racial/ethnic groups in the United States (U.S.) [20,21] and inform potential strategies to prevent dementia for people of all races/ethnicities. Social factors like neighborhood disadvantage are differentially distributed across racial/ethnic groups, and other neighborhood factors, such as residence in ethnic enclaves, have been linked with some indicators of better health and health behaviors in minoritized racial/ethnic groups – possibly via social support and social cohesion – although evidence is mixed [22–24].

We evaluated the association between a U.S. Census-based neighborhood disadvantage metric and dementia incidence among Asian American and non-Latino white older adult Kaiser Permanente Northern California members. Additionally, we evaluated the extent to which neighborhood Asian ethnic density modified the association between neighborhood disadvantage and dementia incidence. We hypothesized that neighborhood disadvantage would be associated with dementia incidence among Asian American and non-Latino white older adults, but that the association would be weaker among Asian Americans living in a neighborhood with a high concentration of Asian residents.

Methods

Study population

Kaiser Permanente Northern California (KPNC) is an integrated health care delivery system that provides comprehensive medical care to more than 4 million members. KPNC members are generally representative of the geographic region, although income extremes tend to be underrepresented [25–27]. KPNC members ages 65+ are similar to the Northern California population with respect to history of chronic conditions, including diabetes, hypertension, heart disease, asthma, obesity, and health behaviors, including smoking and sedentary behavior [25].

The analytic sample comprised Asian American and non-Latino white KPNC members who participated in one of two harmonized health surveys: the California Men's Health Survey (CMHS) (administered 2002–2003) [28], or the Kaiser Permanente Research Program on Genes, Environment, and Health (RPGEH) survey (administered 2007–2009) [29,30]. Individuals eligible for the present analysis were ages 60 to 89 years at the time of survey. Participants were followed from time of survey until dementia diagnosis, lapse in health plan membership ≥90 days, death, or administrative censoring at end of study follow up (February 29th, 2020). Of the 184,492 Asian American and non-Latino white participants, we excluded 4,524 (2.5%) participants with a dementia diagnosis in electronic health records prior to survey, 8,614 (4.7%) participants missing geocoded address information at the block group-level, and 3,866 (2.1%) participants living in counties with fewer than 15 Asian American study participants. The final analytic sample included 167,488 participants (n=18,103 Asian Americans, n=149,385 non-Latino whites) residing in 17 counties and 6,503 block groups in Northern and Central California.

Survey participants provided informed consent at participation; use of the de-identified data (including ages top-coded at 90 years and masked geographic identifiers) for the current study was approved by the University of California, Los Angeles Institutional Review Board (#19–000794).

Measures

Race/ethnicity—Race/ethnicity was based on self-reported response to the question: "What best describes your race or ethnicity? Mark all groups that apply to you." Asian American response options included "South Asian (Indian, Pakistani, etc.)," "Chinese," "Japanese," "Korean," "Filipino," "Vietnamese," and "Other Southeast Asian (Cambodian, Laotian, etc.)." We considered respondents to be Asian American if they selected any Asian ethnic group alone or in combination with other races/ethnicities (e.g., a participant who marked "Chinese" and "White or European-American" would be considered Chinese in this study). Less than 4.5% of Asian Americans in the sample reported an additional non-Asian race/ethnicity. Survey participants who marked "White or European-American" and did not report any other races/ethnicities were classified as "non-Latino white." If responses to this question were missing, race/ethnicity was derived from KPNC membership databases. The three smallest groups (Southeast Asians (n=200), multi-ethnic Asians (participants who endorsed >1 Asian ethnicity) (n=420), and participants identified as Asian American via membership databases (n=943)) were collapsed into “Other Asian ethnicity.”

Neighborhood-level measures—The primary exposure of interest was the Area Deprivation Index (ADI), a validated, weighted factor-based index of neighborhood disadvantage that uses 17 poverty, education, employment, and housing indicators drawn from U.S. Census data. We analyzed block group-level ADI quintiles relative to the state of California, using ADI deciles derived and provided by the Neighborhood Atlas team [31,32]. Additional details on ADI construction are published [1]. We analyzed ADI as quintiles to evaluate the full ADI distribution without assuming linearity.

Neighborhood Asian ethnic density, measured as the percent of census block group residents that identified as Asian, was conceptualized as a potential modifier of the relationship between neighborhood disadvantage and dementia incidence.

Census block groups were used as a surrogate for neighborhoods [33], and all neighborhood-level measures were calculated using 2000 Census Long Form data (see Table S1). Geographic indicators were assigned to participants based on their geocoded address closest to the year 2000 in KPNC membership databases. Census block group population density was calculated as total population (n)/land area (mi^2).

Incident dementia—Incident dementia was obtained from KPNC electronic health records of any medical encounter type excluding laboratory- or radiology-only encounters between survey administration and end of follow up. Diagnoses for Alzheimer’s disease, vascular dementia, and non-specific dementia were defined using *International Classification of Diseases, Ninth Revision* diagnostic codes until September 2015 and *International Classification of Diseases, Tenth Revision* diagnostic codes between September 2015 and end of follow up (February 29th, 2020) (see Table S2). The diagnosis code lists have been used in other studies among KPNC members [18,20,21,34].

Mortality—Deaths were obtained from the KPNC mortality database, which includes mortality data from KPNC clinical and administrative records, Social Security Administration records, the National Death Index, and State of California death records.

Individual-level covariates—Age at survey and sex (female, male) were abstracted from KPNC membership databases. All additional individual-level variables were ascertained via survey. Covariates considered as potential confounders included educational attainment (less than high school, high school, some college, college degree or greater) and household income per person, calculated by taking the upper bound of each self-reported household income category (less than $20,000, $20,000-$39,999, $40,000-$59,999, $60,000-$99,999, and $100,000 or more, using $140,000 as the upper bound for this category [35]) and dividing by the square root of household size (top-coded at five or more household members). To describe the sample, we also examined participant nativity (U.S. vs. foreign born), living alone vs. living with others, married/living as if married (yes vs. no), self-rated health (excellent/very good/good vs. fair/poor), and self-reported history of hypertension (yes vs. no) and diabetes (yes vs. no).

Statistical analysis

Missing data—To address covariate missingness (which ranged from 0–15.7% missingness per variable in the full sample; see Table S3), multiple imputation with chained equations and fully conditional specification [36] was implemented. Rubin's rules were used to pool regression models across imputations.

Age was top-coded at 90 years for de-identification. For participants who remained under follow up after age 90, ages at dementia, death, and censoring (lapse in health plan membership or administrative censoring) were imputed as described elsewhere [18].

Analytic strategy—We constructed race/ethnicity-stratified (Asian American and non-Latino white) Cox proportional hazards models with time-on-study as the timescale to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) relating neighborhood disadvantage quintiles (relative to the least disadvantaged quintile) and dementia incidence. We considered nested models with covariate sets that aimed to control for confounding of effects of neighborhood disadvantage on dementia incidence. In Model 1, we adjusted for participant age at survey (centered at 60 years), participant sex, and census block group population density (per 1,000 people, centered at the sample mean). In Model 2, we additionally adjusted for participant educational attainment. In Model 3, we additionally adjusted for participant household income per person (centered at the sample mean and rescaled per $10,000). Individual-level socioeconomic measures (i.e., educational attainment and income) were not collinear with ADI (Spearman correlation coefficients of $|r| < 0.3$). Measured comorbidities (i.e., self-reported hypertension and diabetes) were conceptualized as potential mediators and therefore not included in models.

To evaluate potential effect modification by neighborhood Asian ethnic density, we fit an additional model (Model 4) that adjusted for all Model 3 covariates plus neighborhood Asian ethnic density (per 10 percentage points, centered at the mean), and a model (Model 5) that additionally included an interaction term between neighborhood disadvantage and neighborhood Asian ethnic density. We evaluated interaction term coefficients and conducted multivariate Wald tests (equivalent to likelihood ratio tests in large samples) to compare Model 4 vs. 5 [36].

To evaluate potential heterogeneity between Asian ethnic groups, we fit Asian ethnic group-specific models among the largest Asian ethnic groups in the sample (Chinese, Filipino, Japanese, South Asian, Korean, and Vietnamese). Hazard ratios were not reported for ADI quintile-ethnicity groups with <5 dementia cases.

In sensitivity analyses, we included a county of residence fixed effect in all models to account for geographic clustering. In Asian ethnic group-specific models, we collapsed smaller counties with neighboring counties as needed to ensure at least one dementia case per cell. We also constructed a model that adjusted for nativity in addition to Model 3 covariates among non-Latino whites and Asian Americans overall. Consistent with prior work on ADI and dementia-related outcomes [8,11,13], we also evaluated the 20% most versus 80% least disadvantaged neighborhoods. Finally, we assessed Cox proportional hazard models with age as the timescale to ensure results were not sensitive to timescale specification.

Analyses were conducted using R version 4.1.1. Code for this project is available online: https://github.com/Mayeda-Research-Group/ADI-ADRD.

Results

A total of n=18,103 Asian Americans and n=149,385 non-Latino whites were followed for up to 18 years for incident dementia. The largest Asian ethnic groups represented were Chinese, Filipinos, Japanese, South Asians, Koreans, and Vietnamese. At baseline, Asian Americans overall were slightly younger, had lower average household income per person, and were less likely to live alone than non-Latino whites, except for Japanese Americans, who were slightly older, had higher household income per person, and were more likely to live alone than other Asian ethnic groups (Table 1). Asian Americans were much more likely to be foreign born than non-Latino whites, although this varied by Asian ethnic group: over 90% of Filipinos, South Asians, Koreans, and Vietnamese were born outside of the U.S., whereas 28.4% of Japanese were born outside the U.S. A higher proportion of Asian Americans were represented in both the highest and lowest educational attainment categories compared with non-Latino whites. Asian Americans overall were more likely to report history of hypertension, diabetes, and rate their health as fair or poor compared with non-Latino whites. Among Asian ethnic groups, Filipinos (27.1%) and South Asians (28.2%) were more likely to report history of diabetes, and over half of Filipinos reported history of hypertension.

Overall, the sample tended to live in less disadvantaged neighborhoods than the overall California population (e.g., approximately 5% of the sample lived in the most disadvantaged quintile compared to 20% of the overall California population). Asian Americans tended to live in less disadvantaged neighborhoods than non-Latino whites, although this varied across Asian ethnic groups (Figures 1a and 1b). Asian Americans also tended to live in neighborhoods with higher Asian population density than non-Latino whites; distributions of Asian ethnic density skewed slightly higher for Chinese, Filipino, and Vietnamese and skewed lower among Japanese relative to other Asian ethnic groups.

Among Asian Americans, over an average follow up of 9.9 years, 12.4% received an incident dementia diagnosis, and 16.1% died (Table 1). Among non-Latino whites, over an average follow up of 9.3 years, 15.2% received an incident dementia diagnosis and 22.1% died (Table 1).

In Cox models adjusted for age, sex, census tract population density, participant educational attainment, and participant household income per person (Model 3), there was a non-linear relationship between higher neighborhood disadvantage quintile and higher dementia incidence among non-Latino whites (Table 2, Figure 2). Among Asian Americans overall and within Asian ethnic groups, there were not consistent associations between neighborhood disadvantage and dementia incidence. While hazard ratios relating neighborhood disadvantage and dementia incidence varied across Asian ethnic groups, estimates were imprecise (Table S4, Figure 3).

Among Asian Americans and non-Latino whites, the relationship between Asian ethnic density and dementia incidence was close to the null (Model 4 HR (95% CI) per 10 percentage points higher 1.01 (0.98–1.03) and 1.02 (1.01–1.03), respectively) (Table 2). Among Asian ethnic groups, Asian ethnic density HRs were close to the null and imprecise (Table S4). In models evaluating potential effect modification by neighborhood Asian ethnic density, the association between neighborhood disadvantage and dementia incidence among was similar regardless of neighborhood Asian ethnic density among non-Latino whites and Asian Americans overall (Table S5). Among Asian ethnic groups, estimates of potential effect modification by Asian ethnic density varied but were imprecise (Table S5).

Sensitivity analyses additionally adjusting for county of residence (Tables S6 and S7), additionally adjusting for nativity (Figure S1), evaluating the 20% most versus 80% least disadvantaged neighborhoods (Figure S2), and Cox models with age as the timescale (Figures S3a and S3b) yielded similar results.

Discussion

In a large cohort of Asian American and non-Latino white Kaiser Permanente Northern California members, there was a non-linear association between higher neighborhood disadvantage and higher dementia incidence among non-Latino whites, while among Asian Americans estimates were close to the null. Point estimates varied by Asian ethnic group, but there was no clear evidence of an association between neighborhood disadvantage and dementia incidence for any group.

Our findings among non-Latino whites are consistent with some prior work in predominantly non-Latino white samples reporting an association between higher neighborhood disadvantage and dementia-related outcomes, including lower cognitive test performance, cognitive decline, and dementia-related biomarkers [8,11–13]. For example, Hunt et al. found that living in the 20% most disadvantaged neighborhoods was associated with greater brain atrophy in two community-dwelling cohorts in Wisconsin [11]. However, most prior work evaluates ADI dichotomously (20% most versus 80% least disadvantaged neighborhoods). Our results suggested that living in any relatively disadvantaged neighborhood was associated with higher dementia incidence compared to living in the least disadvantaged neighborhoods among non-Latino whites (e.g., HR (95% CI) = 1.09 (1.04, 1.13) for the third vs. first (least disadvantaged) quintile of neighborhood disadvantage).

Our finding that neighborhood disadvantage was associated with dementia incidence among non-Latino whites, but not among Asian Americans was unexpected. There are several potential explanations for this. First, our results could reflect true differences in the impact of neighborhood disadvantage due to differences in distribution of effect modifiers (e.g., greater buffering of neighborhood disadvantage effects by social support among Asian Americans). Second, findings could be due to differences in confounding structures across race/ethnicity (i.e., residual confounding among non-Latino whites but not among Asian Americans). Finally, neighborhood disadvantage may influence dementia risk among older adults via social and physical characteristics (e.g., stress and access to greenspace) that influence dementia pathology and cognitive resilience [33,37,38]. However, it is possible that among Asian Americans, the ADI (a marker of relative material deprivation, such as access to socioeconomic resources like occupational opportunities and health care [1,8]) does not capture the most relevant pathways through which neighborhood context impacts dementia incidence. For example, neighborhood-level factors such as limited access to cultural institutions and increased discrimination, which have been associated with greater stress and worse mental health among Asian Americans [24,39], may be more strongly associated with dementia risk than material deprivation. Data were not available to evaluate these competing explanations, but this should be a topic of future research.

This is the first study to evaluate the relationship between neighborhood disadvantage and dementia risk by Asian ethnic group. Our point estimates of the neighborhood disadvantage-dementia association show heterogeneity across Asian ethnic groups, but estimates were imprecise. This heterogeneity may reflect differences in historical immigration patterns across groups (due to US and global political and economic factors) that in turn may yield differences in socioeconomic opportunities and experiences of discrimination by ethnic group [40]. For example, immigration from China and India after the 1965 U.S. immigration reforms has included many highly-educated professionals seeking skilled work, whereas many Vietnamese Americans immigrated to the U.S. as refugees during and after the Vietnam War [40].

We hypothesized that among Asian Americans, residence in ethnic enclaves would confer protection against living in a disadvantaged neighborhood via culturally-relevant social capital and social support, as well as less exposure to discrimination. However, our results did not support this hypothesis. Neighborhood Asian ethnic density was not associated with dementia incidence and the association between neighborhood disadvantage and dementia incidence did not vary by neighborhood Asian ethnic density among Asian Americans overall or non-Latino whites. Among Japanese and Koreans, point estimates for the interaction term between neighborhood disadvantage and neighborhood Asian ethnic density were consistent with residence in neighborhoods with higher Asian ethnic composition conferring protection against effects of neighborhood disadvantage on dementia risk, but estimates were imprecise. There are several possible explanations for these findings. It is possible that residence in an ethnic enclave does not modify the association between neighborhood disadvantage and dementia incidence among Asian Americans and non-Latino whites. It is also possible that neighborhood Asian ethnic density is not a good proxy for the purported underlying mechanisms. Study of more direct measures that examine these pathways among Asian Americans is warranted.

This study benefited from a large Asian American sample followed for incident dementia over a mean follow-up of >9 years, which supported analyses among Asian Americans overall and stratified on Asian ethnic group. This study also had limitations. Measurement limitations include that we used census block groups as a proxy for neighborhoods [33], which may not adequately capture how one thinks about or experiences their community.

Second, like most studies examining neighborhood disadvantage and dementia-related outcomes [8,13–15], we were limited to measuring neighborhood disadvantage in late-life based on address availability. Given that dementia-related pathology takes years to develop and early-life experiences are thought to play an important role in shaping cognitive reserve [41,42], it is possible we did not capture neighborhood disadvantage in the most etiologically-relevant lifecourse period. Finally, this study also captured dementia diagnoses using electronic health records; thus, our analysis did not capture undiagnosed dementia cases. If missed dementia diagnoses were more common among those residing in more disadvantaged neighborhoods, our results could be biased toward the null; if differential underdiagnosis of dementia by neighborhood disadvantage is more pronounced among Asian Americans than non-Latino whites, this could bias results more toward the null for Asian Americans than non-Latino whites. Notably, prior work among KPNC members has suggested there are not significant delays in dementia diagnosis for Asian American compared with non-Latino white members [43]. Spatial autocorrelation could not be evaluated because geographic identifiers were masked; although sensitivity analyses accounting for geographic clustering with a county of residence fixed effect yielded similar results, residual correlation by participant neighborhood could affect standard error (precision) estimates. Finally, all racial/ethnic groups include diverse individuals, and heterogeneity beyond the racial/ethnic group stratifications we examined could be of interest in future work.

Our sample skewed toward less disadvantaged neighborhoods relative to California as a whole, reflecting that participants resided in more urban counties in Northern and Central California, and all had health insurance. Prior work showed healthy selection into this sample compared to the California population and overall KPNC membership [18]. It is possible that the relationship between neighborhood disadvantage and dementia incidence would differ in other geographic regions and for Asian Americans with different health profiles or without access to healthcare.

Our findings build on prior studies linking neighborhood disadvantage with dementia-related outcomes, and suggest this relationship persists across more disadvantaged neighborhoods relative to the least disadvantaged neighborhoods in California among non-Latino white older adults. Given that one in four adults who survive to age 65 is expected to experience dementia [20], these results suggest that reducing neighborhood disadvantage could yield important reductions in dementia burden. This study also builds on work showing lower dementia incidence among Asian Americans than non-Latino whites [20] and heterogeneity between Asian ethnic groups [21]. Asian Americans are the fastest-growing racial/ethnic group in the U.S. [44], but are understudied. Our findings raise key questions about why neighborhood disadvantage is related to dementia risk for non-Latino whites but not Asian Americans. Although puzzling, answering this question may garner further insights into dementia etiology and potential dementia prevention strategies for all communities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Systematic review:

The authors reviewed literature on neighborhood socioeconomic exposures, including the Area Deprivation Index, and dementia-related outcomes among older adults via online resources (e.g., PubMed, Google Scholar). Research examining ethnic enclaves and health outcomes, particularly among Asian Americans, was also reviewed. Relevant work is cited in-text.

Interpretation:

In a northern California cohort of older adults, we found a non-linear association between higher neighborhood disadvantage and higher dementia incidence among non-Latino whites, while among Asian Americans results were close to the null. Neighborhood Asian ethnic density did not appear to modify the association between neighborhood disadvantage and dementia incidence.

Future directions:

Future research should aim to explore why neighborhood disadvantage is related to dementia risk for non-Latino whites but not Asian Americans. Understanding the potentially different mechanisms driving dementia incidence across racial/ethnic groups could provide insights into dementia etiology and inform dementia prevention efforts.

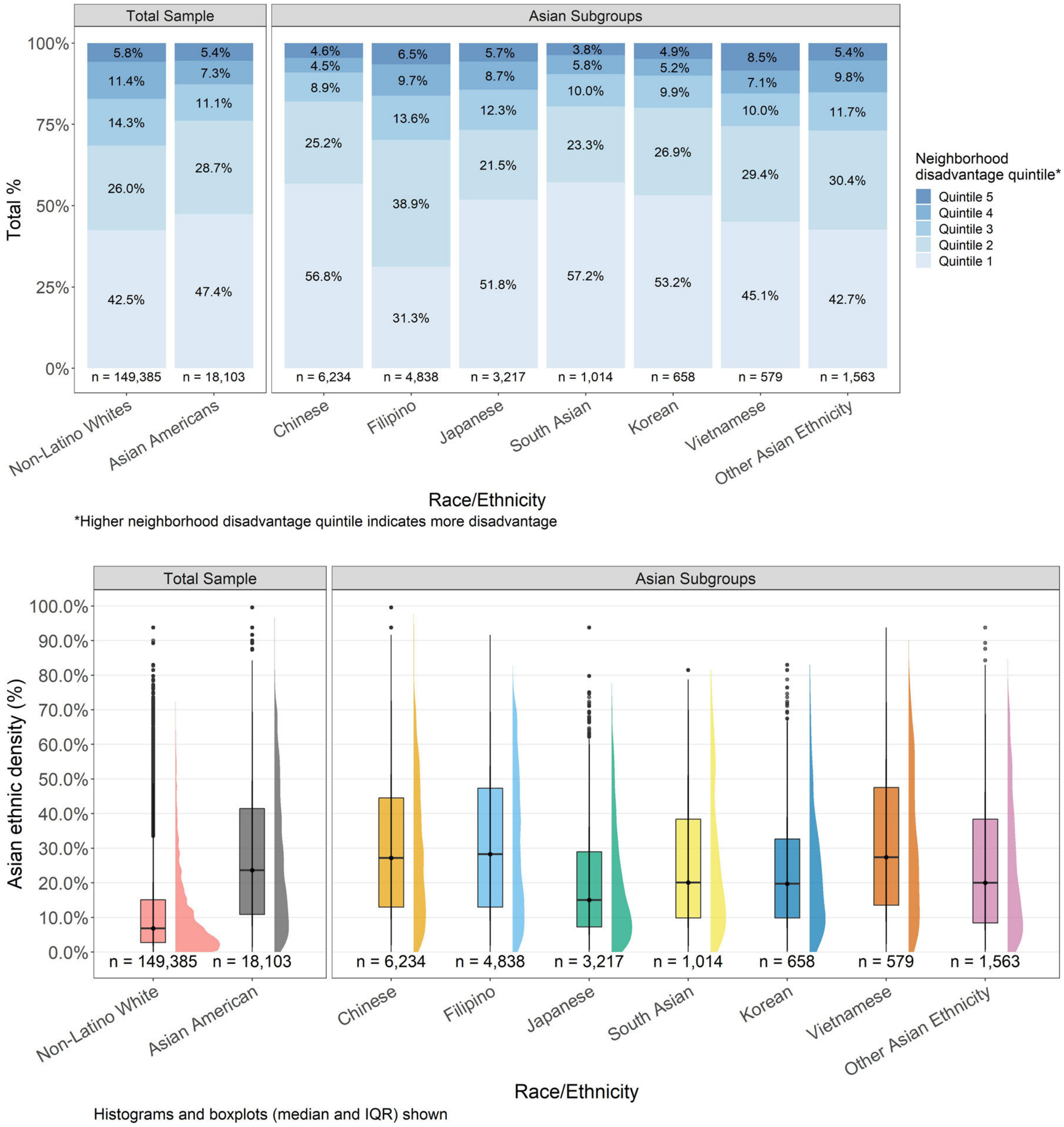

Figure 1.

Distributions of (A) Neighborhood disadvantage quintiles and (B) neighborhood Asian ethnic density (% Asian residents per block group) stratified by cohort member race/ethnicity

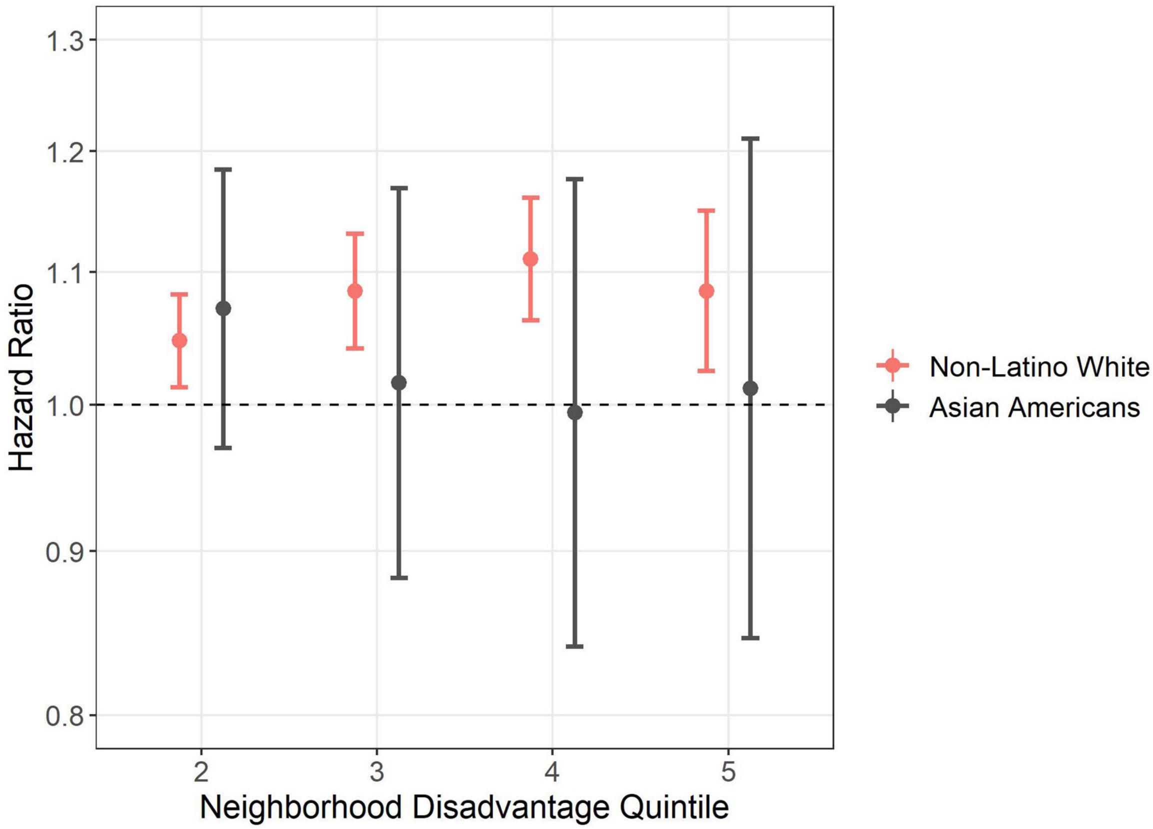

Figure 2.

Hazard ratios (95% CI) relating neighborhood disadvantage quintiles (relative to the lowest quintile) and dementia incidence from Cox proportional hazards models adjusted for age, sex, census block group population density, participant educational attainment, and household income per person, stratified by race/ethnicity.

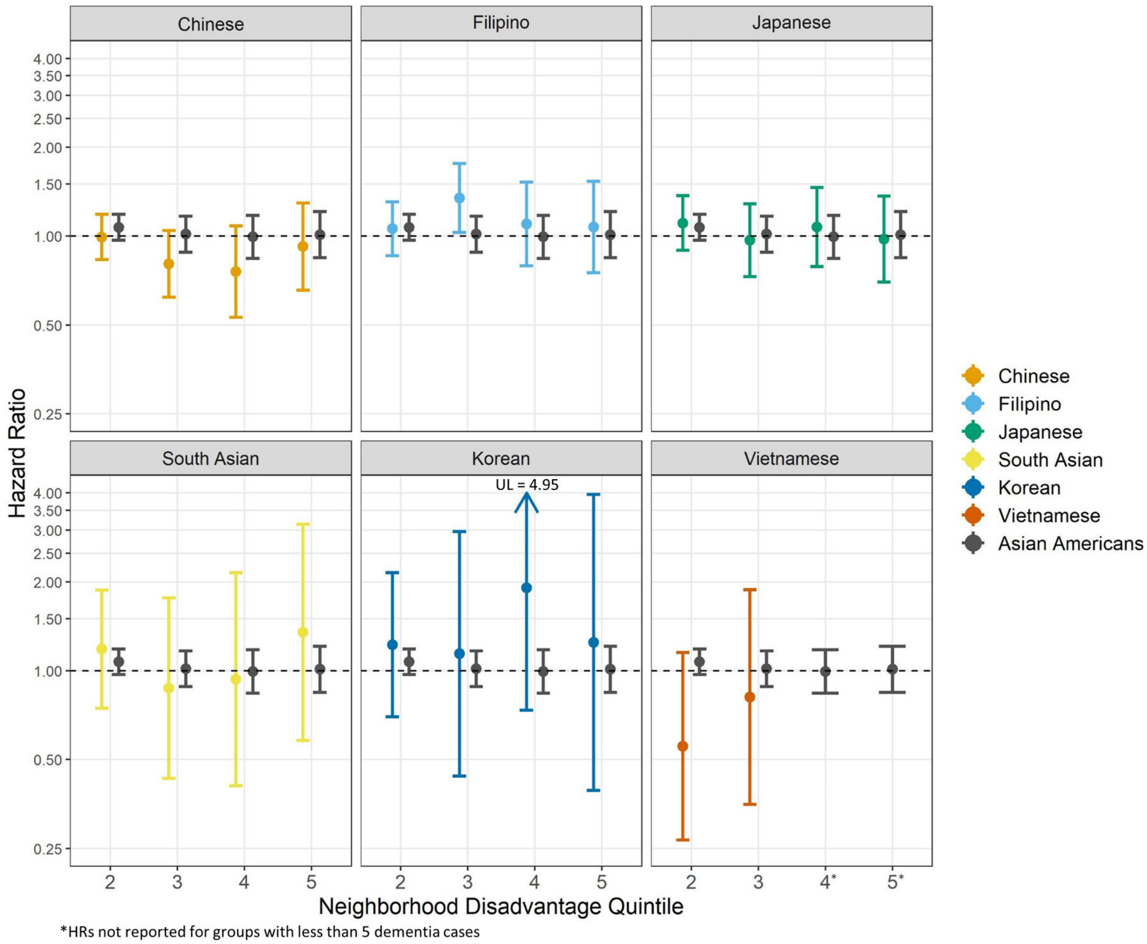

Figure 3.

Hazard ratios (95% CI) relating neighborhood disadvantage quintiles (relative to the lowest quintile) and dementia incidence from Cox proportional hazards models adjusted for age, sex, census block group population density, participant educational attainment, and household income per person, stratified by Asian ethnic group. For reference, results for all Asian Americans included in grey.

Table 1.

Characteristics of the sample averaged over 20 imputed datasets, stratified by race/ethnicity

	Whole Sample				Asian Subgroups													
	Non-Latino White		All Asians		Chinese		Filipino		Japanese		South Asian		Korean		Vietnamese		Other Asian Ethnicity[a]	
	N=149,385		N=18,103		N=6,234		N=4,838		N=3,217		N=1,014		N=658		N=579		N=1,563	
Survey age, years (mean [SD])	71.8	(7.8)	70.4	(7.2)	70.6	(7.2)	69.4	(6.8)	72.6	(7.7)	68.7	(6.4)	69.2	(6.1)	68.0	(5.5)	70.8	(7.3)
Female (%)	84,947	(56.9)	9,653	(53.3)	3,157	(50.6)	2,759	(57.0)	2,015	(62.6)	399	(39.3)	372	(56.5)	263	(45.4)	688	(44.0)
Household income per person, in thousands of dollars (mean [SD])	55.1	(27.8)	44.9	(27.0)	46.3	(28.3)	39.0	(24.0)	53.3	(26.7)	49.0	(28.7)	41.3	(24.7)	33.8	(22.6)	42.9	(25.9)
Educational attainment (%)																		
Less than high school (Grades 1-<12)	9,015	(6.0)	2,302	(12.7)	1,062	(17.0)	493	(10.2)	218	(6.8)	123	(12.1)	72	(10.9)	119	(20.5)	216	(13.8)
High school/GED	28,693	(19.2)	2,754	(15.2)	938	(15.1)	530	(10.9)	719	(22.4)	103	(10.2)	103	(15.6)	84	(14.4)	277	(17.7)
Some college	45,487	(30.4)	4,105	(22.7)	1,440	(23.1)	1,023	(21.2)	882	(27.4)	126	(12.4)	115	(17.5)	137	(23.6)	383	(24.5)
Bachelor’s degree or greater	66,190	(44.3)	8,943	(49.4)	2,794	(44.8)	2,792	(57.7)	1,399	(43.5)	663	(65.4)	369	(56.0)	240	(41.5)	686	(43.9)
Foreign born (%)	14,813	(9.9)	12,788	(70.6)	4,305	(69.1)	4,361	(90.1)	914	(28.4)	948	(93.5)	599	(91.0)	575	(99.3)	1,087	(69.6)
Live alone (%)	38,213	(25.6)	2,501	(13.8)	865	(13.9)	418	(8.6)	771	(24.0)	99	(9.8)	94	(14.3)	46	(7.9)	207	(13.2)
Married, living as if married (%)	97,284	(65.1)	13,438	(74.2)	4,866	(78.0)	3,483	(72.0)	2,127	(66.1)	831	(82.0)	511	(77.6)	459	(79.2)	1,162	(74.4)
Self-reported history of diabetes (%)	21,215	(14.2)	3,888	(21.5)	1,061	(17.0)	1,313	(27.1)	634	(19.7)	286	(28.2)	123	(18.7)	115	(19.9)	356	(22.8)
Self-reported history of hypertension (%)	65,322	(43.7)	8,328	(46.0)	2,705	(43.4)	2,531	(52.3)	1,492	(46.4)	433	(42.7)	235	(35.7)	247	(42.7)	685	(43.8)
Fair/poor self-rated health	26,857	(18.0)	4,582	(25.3)	1,621	(26.0)	1,337	(27.6)	641	(19.9)	209	(20.6)	176	(26.8)	168	(29.1)	430	(27.5)
End of follow up event (%)																		
Dementia	22,721	(15.2)	2,250	(12.4)	753	(12.1)	549	(11.3)	542	(16.8)	109	(10.7)	67	(10.2)	52	(9.0)	178	(11.4)
Death	32,974	(22.1)	2,918	(16.1)	1,038	(16.7)	732	(15.1)	573	(17.8)	144	(14.2)	83	(12.6)	63	(10.9)	285	(18.2)
Administratively censored	62,641	(41.9)	8,618	(47.6)	3,210	(51.5)	2,179	(45.0)	1,446	(44.9)	497	(49.0)	306	(46.5)	300	(51.8)	680	(43.5)
End of membership	22,697	(15.2)	3,399	(18.8)	903	(14.5)	1,211	(25.0)	409	(12.7)	235	(23.2)	175	(26.6)	151	(26.1)	315	(20.2)
Censored 90+[b]	8,352	(5.6)	918	(5.1)	330	(5.3)	167	(3.5)	247	(7.7)	29	(2.9)	27	(4.1)	13	(2.2)	105	(6.7)

	Whole Sample		Asian Subgroups						
	Non-Latino White	All Asians	Chinese	Filipino	Japanese	South Asian	Korean	Vietnamese	Other Asian Ethnicity[a]
	N=149,385	N=18,103	N=6,234	N=4,838	N=3,217	N=1,014	N=658	N=579	N=1,563
Follow up time (mean [SD])	9.3 (4.5)	9.9 (4.6)	10.5 (4.6)	9.3 (4.6)	9.9 (4.6)	9.9 (4.5)	9.7 (4.6)	10.0 (5.0)	9.3 (4.5)

[a]Other Asian ethnicity group included other Southeast Asians, Multi-ethnic Asians, and participants identified as Asian by the KPNC health plan membership databases

[b]For de-identification purposes, censoring events after age 90 were not differentiated between lapse in health plan membership and administrative censoring.

Table 2.

Hazard ratios (95% CI) relating higher neighborhood disadvantage quintiles (relative to least disadvantaged), Asian ethnic density, and dementia incidence by race/ethnicity from Cox proportional hazards models.

Model	Term	Non-Latino White Hazard Ratio (95% CI) (n=149,385)	Asian American Hazard Ratio (95% CI) (n=18,103)
1	Neighborhood disadvantage quintile 2 vs. quintile 1	1.09 (1.05, 1.12)	1.10 (0.99, 1.21)
	Neighborhood disadvantage quintile 3 vs. quintile 1	1.15 (1.10, 1.20)	1.04 (0.91, 1.20)
	Neighborhood disadvantage quintile 4 vs. quintile 1	1.19 (1.14, 1.25)	1.03 (0.87, 1.22)
	Neighborhood disadvantage quintile 5 vs. quintile 1	1.19 (1.13, 1.26)	1.05 (0.88, 1.26)
2	Neighborhood disadvantage quintile 2 vs. quintile 1	1.07 (1.04, 1.11)	1.09 (0.99, 1.21)
	Neighborhood disadvantage quintile 3 vs. quintile 1	1.12 (1.07, 1.17)	1.03 (0.90, 1.19)
	Neighborhood disadvantage quintile 4 vs. quintile 1	1.16 (1.11, 1.21)	1.01 (0.86, 1.20)
	Neighborhood disadvantage quintile 5 vs. quintile 1	1.14 (1.08, 1.21)	1.03 (0.86, 1.24)
3	Neighborhood disadvantage quintile 2 vs. quintile 1	1.05 (1.01, 1.08)	1.07 (0.97, 1.18)
	Neighborhood disadvantage quintile 3 vs. quintile 1	1.09 (1.04, 1.13)	1.02 (0.88, 1.17)
	Neighborhood disadvantage quintile 4 vs. quintile 1	1.11 (1.06, 1.16)	0.99 (0.84, 1.18)
	Neighborhood disadvantage quintile 5 vs. quintile 1	1.09 (1.02, 1.15)	1.01 (0.85, 1.21)
4	Neighborhood disadvantage quintile 2 vs. quintile 1	1.05 (1.02, 1.09)	1.07 (0.97, 1.19)
	Neighborhood disadvantage quintile 3 vs. quintile 1	1.10 (1.05, 1.15)	1.02 (0.89, 1.18)
	Neighborhood disadvantage quintile 4 vs. quintile 1	1.13 (1.08, 1.18)	1.00 (0.84, 1.18)
	Neighborhood disadvantage quintile 5 vs. quintile 1	1.10 (1.04, 1.17)	1.02 (0.85, 1.22)
	Asian ethnic density[a]	1.02 (1.01, 1.03)	1.01 (0.98, 1.03)
5	Neighborhood disadvantage quintile 2 vs. quintile 1	1.05 (1.02, 1.09)	1.09 (0.96, 1.24)
	Neighborhood disadvantage quintile 3 vs. quintile 1	1.11 (1.06, 1.17)	1.06 (0.91, 1.24)
	Neighborhood disadvantage quintile 4 vs. quintile 1	1.15 (1.09, 1.22)	1.05 (0.88, 1.26)
	Neighborhood disadvantage quintile 5 vs. quintile 1	1.10 (1.04, 1.17)	1.08 (0.88, 1.31)
	Asian ethnic density[a]	1.01 (1.00, 1.03)	1.02 (0.99, 1.05)
	Neighborhood disadvantage quintile 2 x Asian ethnic density	1.00 (0.98, 1.03)	0.99 (0.94, 1.04)
	Neighborhood disadvantage quintile 3 x Asian ethnic density	1.03 (0.99, 1.07)	0.96 (0.89, 1.05)
	Neighborhood disadvantage quintile 4 x Asian ethnic density	1.04 (0.99, 1.09)	0.94 (0.86, 1.03)
	Neighborhood disadvantage quintile 5 x Asian ethnic density	1.01 (0.96, 1.07)	0.95 (0.87, 1.04)

[a]Asian ethnic density per 10 percentage points, centered at the overall mean

Model 1: adjusted for age, sex, census block group population density

Model 2: Model 1 covariates + participant educational attainment Model 3: Model 2 covariates + participant household income per person

Model 4: Model 3 covariates + Asian ethnic density

Model 5: Model 4 covariates + Asian ethnic density + neighborhood disadvantage x Asian ethnic density