Inequalities in dementia incidence between six racial and ethnic groups over 14 years

Elizabeth Rose Mayeda[a], M. Maria Glymour[a], Charles P. Quesenberry[b], Rachel A. Whitmer[b,a,*]

[a]*Department of Epidemiology and Biostatistics, University of California, San Francisco, San Francisco, CA, USA*
[b]*Kaiser Permanente Division of Research, Oakland, CA, USA*

Abstract

Introduction: Reducing racial/ethnic disparities is a primary objective of the National Alzheimer's Plan (NAPA), yet direct comparisons within large samples representing diversity of the United States are lacking.

Methods: Dementia incidence from January 1, 2000 to December 31, 2013 and a 25-year cumulative risk in 274,283 health care members aged 64+ (n = 18,778 African-American, n = 4543 American Indian/Alaska Native [AIAN], n = 21,000 Latino, n = 440 Pacific Islander, n = 206,490 white, n = 23,032 Asian-Americans). Cox proportional hazard models were adjusted for age, sex, medical utilization, and comorbidities.

Results: Dementia incidence (n = 59,555) was highest for African-Americans (26.6/1000 person-years) and AIANs (22.2/1000 person-years); intermediate for Latinos (19.6/1000 person-years), Pacific Islanders (19.6/1000 person-years), and whites (19.3/1000 person-years) and lowest among Asian-Americans (15.2/1000 person-years). Risk was 65% greater for African-Americans (hazard ratio = 1.65; 95% confidence interval = 1.58–1.72) versus Asian-Americans. Cumulative 25-year risk at age 65 was as follows: 38% African-Americans, 35% AIANs, 32% Latino, 25% Pacific Islanders, 30% white, and 28% Asian-Americans.

Discussion: Dementia rates varied over 60% between groups, providing a comprehensive benchmark for the NAPA goal of reducing disparities.

© 2016 The Alzheimer's Association. Published by Elsevier Inc. All rights reserved.

Keywords: Dementia; Race; Ethnicity; Disparities; Cohort; Epidemiology

1. Background

Reducing racial/ethnic disparities in dementia has been identified as a national priority by both the National Alzheimer's Plan (NAPA) [1] and the Alzheimer's Disease-Related Dementias Conference [2] road maps. It is widely believed there are racial/ethnic disparities in dementia incidence in the United States [3,4], and social and behavioral factors are thought to be major drivers of these inequalities [5–8]. However, the currently available evidence is incomplete and difficult to interpret. No prior research has directly compared dementia incidence in a single population representing the diversity of the United States, including African-Americans, American Indians and Alaska Natives (AIAN), Latinos, Pacific Islanders, whites, and Asian-Americans. Most research on racial/ethnic inequalities in dementia includes only one or two racial/ethnic group or compares dementia prevalence or incidence across studies. This is problematic because variability in diagnostic criteria can strongly influence estimates [9,10] and geographic patterns may also contribute to differences across studies [11]. Furthermore, to our knowledge, no population-based studies have included Pacific Islanders or AIANs. Dementia risk is reported to be up to twice as high for African-Americans compared with whites [5,12–15]. Evidence on dementia risk among Latinos is less consistent but suggests elevated dementia risk among

*Corresponding author. Tel.: +1-510-891-3400; Fax: +1-510-891-3761.

E-mail address: Rachel.Whitmer@kp.org

Caribbean Latinos in New York City [12], but not among Mexican Americans in California [16], compared with whites. Dementia incidence rates among Japanese Americans have been reported to be similar or lower compared with whites in other studies [17,18]. To our knowledge, there is no work examining dementia incidence among other Asian-American populations.

The present study leverages 14 years of prospective data on a large, diverse older adult cohort in northern California with equal access to health care. Our primary objective was to evaluate racial/ethnic inequalities in dementia incidence among African-Americans, AIANs, Latinos, Pacific Islanders, whites, and Asian-Americans in this sample. Because dementia risk increases with age and some studies have shown dementia risk to be higher among women than men [4] and racial/ethnic disparities often vary by sex and age [19], we examined inequalities overall and also stratified by sex and age. Finally, because higher annual incidence rates of dementia may be offset by differences in mortality due to other causes, we estimated the 25-year cumulative incidence of dementia for each group.

2. Methods

2.1. Study population

Kaiser Permanente Northern California (KPNC) is a large, integrated health care delivery system providing comprehensive medical care to over 3 million members (30% of the geographic region). The member population is generally representative of the overall regional population, but underrepresents individuals at extreme tails of the income distribution [20–22]. Seniors (age ≥65 years) covered by KPNC are similar to the general population of seniors residing in northern California with respect to history of chronic conditions, including diabetes, hypertension, heart disease, asthma, and lifestyle factors, including smoking, obesity, and sedentary lifestyle [22]. California Health Interview Survey [23] results show similar patterns of racial inequalities for major chronic conditions as those observed in KPNC (authors' calculation). The present study includes KPNC members who were enrolled and aged ≥60 years as of January 1, 1996 (the year KPNC implemented electronic medical records). To ensure dementia diagnoses detected were incident cases, we included a 4-year washout period (January 1, 1996–December 31, 1999). The present analyses include members who were still alive, KPNC members, and had no dementia diagnosis as of January 1, 2000. Cohort members were followed for incident dementia until end of health plan membership (defined as a gap in membership of ≥3 months), death, or December 31, 2013 (end of study period). On average, 1.2% of the baseline population ended health plan membership annually; this number was slightly higher among Pacific Islanders, for whom the rate was 2.3% annually.

2.2. Measures

2.2.1. Exposure

Self-reported race/ethnicity was retrieved from health plan membership databases and categorized into six groups as follows: African-American or black, AIAN, Native Hawaiian or other Pacific Islander, Latino or Hispanic, non-Latino white, and Asian-American. Members who identified as other or multiracial were excluded from analyses due to small sample sizes. The primary Latino subgroup represented in health plan members is Mexican Americans. The primary Asian-American subgroups represented in health plan members are Chinese Americans, Filipino Americans, and Japanese Americans, but we did not evaluate subgroups separately.

2.2.2. Outcome

Dementia diagnoses were identified from electronic medical records of inpatient and outpatient encounters between January 1, 2000 and December 31, 2013 based on International Classification of Diseases, Ninth Revision (ICD-9) diagnostic codes for Alzheimer's disease (331.0), vascular dementia (290.4x), and nonspecific dementia (290.0, 290.1x, 290.2x, 290.3, 294.2x, and 294.8). Dementia case identification using ICD-9 codes has been used successfully in other publications in this population [24–27]. Dementia diagnosis in neurology, memory clinic, and neuropsychology departments in the KPNC system is typically based on information from medical history, physical examination, mental status examination, blood test, functional ability, and imaging. A similar battery of ICD-9 codes for diagnosis of dementia was found to have a sensitivity of 77% and a specificity of 95% compared with a consensus diagnosis of dementia in a health care system in Seattle, Washington [28]. A similar battery of ICD-9 codes from Medicare claims data had a sensitivity of 87% for a sample of Alzheimer's disease patients ages 65+ who participated in the Consortium to Establish a Registry for Alzheimer's Disease [29]. There were a small number of diagnoses of frontotemporal dementia (331.1x), dementia with Lewy bodies (331.82), and Parkinson's dementia (332.0 + 294.1x) in the KPNC records (cumulative incidence <2% over the entire 18-year washout and follow-up period), and we did not consider these as cases in the current analyses, unless the patient was also diagnosed with a more common diagnostic code.

Mortality was identified from electronic medical records for deaths that occurred within the health care system and the California Automated Mortality Linkage System, which captured deaths from the California State Mortality File and Social Security Death Records. This mortality ascertainment method is standard for epidemiologic studies of KPNC members [25,30].

2.2.3. Covariates

Age and sex were retrieved from KPNC health plan membership databases. We measured baseline characteristics,

including health care utilization and comorbidities, during the washout period (January 1, 1996–December 31, 1999). As a measure of health care utilization, we calculated a dichotomous variable for whether participants had ≥ 1 health care visit (inpatient or outpatient) per year during the washout period. We identified comorbidities, including diabetes, depression, hypertension, stroke (ischemic stroke, transient ischemic attack, and hemorrhagic stroke), and cardiovascular disease (myocardial infarction, heart failure, ischemic heart disease, and peripheral arterial disease) from inpatient and outpatient visits (Supplementary Table 1).

2.3. Statistical analysis

Age-adjusted dementia incidence rates by race/ethnicity were estimated by standardization to the 2000 United States Census population. Dementia incidence rates were also estimated for each racial/ethnic group by sex and age group (64–69, 70–74, 75–79, 80–84, 85–89, or 90+ years). We specified Cox proportional hazards models to estimate the association between race/ethnicity and dementia risk. Because of the strong association between age and dementia incidence, we used age as the timescale, starting from age as of January 1, 2000 until age at dementia diagnosis, death, end of health plan membership, or December 31, 2013 (end of study period). We examined both overall and sex-specific hazard ratios for dementia. We first examined racial/ethnic differences in dementia risk after adjustment for age (as timescale) and sex (model 1). Next, we additionally adjusted for health care utilization (≥ 1 annual health care visit) to account for potential differences in diagnosis rates arising from unequal health care utilization (model 2). To examine whether proximal comorbidities could explain racial/ethnic differences in dementia, we additionally adjusted for depression, hypertension, diabetes, stroke, and cardiovascular disease (model 3). To formally test whether dementia incidence rates differed by sex within a racial/ethnic group, we evaluated whether the 84% confidence intervals (CIs) overlapped to test whether the incidence rates differ at $P < .05$ [31]. To formally test whether racial disparities in dementia incidence differ by sex, we specified a Cox proportional hazards model including both females and males with a multiplicative interaction term between race/ethnicity and sex.

We estimated cumulative incidence of dementia (at 5-year intervals from 5 to 35 years) adjusted for the competing risk of death for individuals who survived dementia-free to age 65 using the Practical Incidence Estimator macro developed by Framingham Study investigators [32]. Cumulative incidence is interpreted as the percent of individuals expected to develop dementia before death over a hypothetical follow-up period. Analyses were performed with SAS version 9.3 (SAS Institute Inc, Cary, NC, USA).

To contextualize the magnitude of inequalities, we applied incidence rates in each race/ethnicity and age stratum to 2013 United States Census population estimates. We then estimated how many dementia cases could be eliminated if all race/ethnic groups had the incidence rate achieved by the lowest risk group.

3. Results

Of the 372,925 KPNC members who were aged ≥ 60 years as of January 1, 1996, 280,147 met eligibility criteria after the washout. We excluded 5864 members who were missing race, mixed race, or were recorded as other or unknown sex, leaving a final analytic cohort of 274,283 members (Fig. 1). At baseline, mean age was 73.4 years and 54.6%
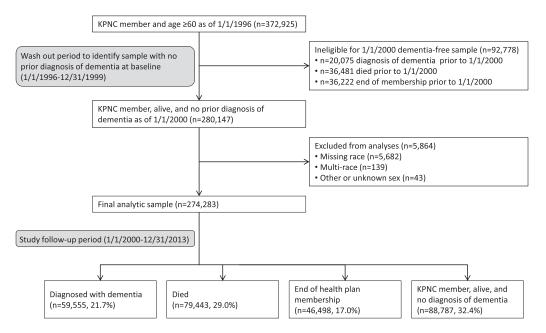

Fig. 1. Flow of study participants. Abbreviation: KPNC, Kaiser Permanente Northern California.

of the sample was female. Regular contact with the health care system was common: over 80% of members had ≥1 annual health care visit. The proportion of members with ≥1 annual health care visit was highest among AIANs and lowest among Pacific Islanders. The proportion of individuals with ≥1 comorbidity was highest among African-Americans and lowest among Pacific Islanders (Table 1).

Over an average of 8.6 years (standard deviation = 4.9) follow-up, 59,555 members (21.7%) were diagnosed with dementia, 79,443 (29.0%) died, 46,498 (17.0%) were lost to follow-up (ended KPNC membership), and 88,787 (32.4%) were still alive and KPNC members without a diagnosis of dementia at end of follow-up.

Age-adjusted dementia incidence rates were highest among African-Americans and AIANs, lowest among Asian-Americans, and intermediate among Latinos, Pacific Islanders, and whites (Table 2). Hazard ratios (95% CIs) adjusted for age (as timescale), sex, and health care utilization relative to Asian-Americans were 1.73 (1.66–1.81) for African-Americans, 1.42 (1.33–1.51) for AIANs, 1.29 (1.23–1.35) for Latinos, 1.28 (1.00–1.65) for Pacific Islanders, and 1.25 (1.21–1.29) for whites (Table 2). Results remained similar after adjustment for comorbidities.

Dementia incidence was highest among African-Americans, followed by AIANs, and lowest among Asian-Americans at all ages (Fig. 2, Supplementary Table 2). Absolute differences in dementia incidence (comparisons based on subtraction) increased with age, but relative differences (comparisons based on ratios) decreased with age. For example, at ages 70–74 years, the incidence rate among African-Americans compared with Asian-Americans was 14 versus six cases per 1000 person-years (absolute difference of eight cases per 1000 person-years; relative excess of 133%), whereas at ages 90+ years, incidence among African-Americans compared with Asian-Americans was 115 versus 84 cases per 1000 person years (absolute difference of 31 cases per 1000 person-years; relative excess of 37%).

Racial/ethnic inequalities were observed for both sexes, although the magnitude of associations tended to be stronger for men (Table 3, Supplementary Table 3). For example, dementia rates were 60% higher among African-American women compared with Asian-American women, whereas dementia rates were 93% higher among African-American men compared with Asian-American men (interaction *P* <.001). In most racial/ethnic groups, dementia incidence rates were similar for women and men until ages 90+ years, when rates were higher for women in some racial/ethnic groups; this difference was statistically significant for whites (Supplementary Table 3, Supplementary Fig. 1).

Observed rates of dementia and mortality predict that among individuals who survive dementia-free to age 65, 38% (36%–39%) of African-Americans, 35% (32%-36%) of AIANs, 32% (31%–33%) of Latinos, 25% (15%–31%) of Pacific Islanders, 30% (29%–30%) of whites, and 28% (27%–29%) of Asian-Americans would be diagnosed with dementia over the next 25 years (Supplementary Table 4 displays cumulative risk estimates for other time periods). Applying the observed dementia incidence rates to the 2013 United States Census population indicates that if these racial/ethnic differences hold nationally, reducing dementia incidence in all groups to the rate among Asian-Americans would prevent more than 190,000 dementia cases annually in the United States.

4. Discussion

In a large population-based sample with equal access to health care followed for 14 years, we found dementia incidence was highest among African-Americans and AIANs,

Table 1
Baseline characteristics of the sample by race/ethnicity

Variable	African-American	American Indian and Alaska Native	Latino	Pacific Islander	White	Asian-American
n	18,778	4543	21,000	440	206,490	23,032
Age (y), mean (SD)	72.7 (6.5)	73.5 (6.3)	71.9 (5.9)	71.5 (7.0)	73.9 (6.7)	71.7 (5.9)
Female, %	54.9	54.3	52.4	49.8	54.9	53.1
≥1 health care visit per year, %	80.5	87.5	81.6	58.0	82.3	78.9
Depression, %	8.2	14.0	11.4	3.6	11.6	5.5
Hypertension, %	68.4	54.4	52.5	44.3	49.9	53.8
Diabetes, %	35.6	29.6	37.2	29.1	21.3	33.5
Stroke, %	9.2	9.5	7.3	7.5	8.5	6.2
Cardiovascular disease*, %	24.6	28.2	20.4	17.7	24.1	16.8
Myocardial infarction	2.3	3.2	2.5	2.5	2.8	2.1
Heart failure	10.0	8.9	6.6	7.5	8.3	5.2
Ischemic heart disease	16.3	21.2	15.7	13.6	17.7	13.4
Peripheral arterial disease	7.7	7.8	5.3	4.1	6.8	3.2
Any comorbidity[†]	79.7	74.2	72.0	59.3	66.7	69.2

Abbreviation: SD, standard deviation.

NOTE. Baseline characteristics collected between 1/1/1996-12/31/1999.

*Cardiovascular disease = myocardial infarction, heart failure, ischemic heart disease, and peripheral arterial disease.

[†]Any comorbidity (depression, hypertension, diabetes, stroke, or cardiovascular disease).

Table 2
Dementia incidence by race/ethnicity, 2000–2013

Race/ethnicity	Events	Person-years	Age-adjusted incidence rate per 1000 person-years (95% CI)	Hazard ratio (95% CI)		
				Model 1	Model 2	Model 3
African-American	4942	157,118	26.60 (25.83–27.37)	1.73 (1.66–1.81)	1.73 (1.66–1.81)	1.65 (1.58–1.72)
American Indian and Alaska Native	1224	41,182	22.18 (20.85–23.52)	1.43 (1.34–1.52)	1.42 (1.33–1.51)	1.32 (1.24–1.41)
Latino	4371	195,686	19.59 (18.97–20.20)	1.29 (1.24–1.35)	1.29 (1.23–1.35)	1.24 (1.19–1.29)
Pacific Islander	61	3246	19.63 (14.51–24.75)	1.26 (0.98–1.63)	1.28 (1.00–1.65)	1.23 (0.95–1.58)
White	45,110	1,750,252	19.35 (19.16–19.54)	1.25 (1.21–1.30)	1.25 (1.21–1.29)	1.22 (1.18–1.26)
Asian-American	3847	224,120	15.24 (14.73–15.74)	1.00 (ref)	1.00 (ref)	1.00 (ref)

Abbreviations: CI, confidence interval; ref, reference.

NOTE. Age-adjusted dementia incidence rates use 2000 US Census as standard. Hazard ratios for dementia are from Cox proportional hazards models. Model 1: adjusted for age (as timescale) and sex; model 2: model 1 + health care utilization (≥1 health care visit per year); and model 3: model 2 + depression, diabetes, hypertension, stroke, and cardiovascular disease.

lowest among Asian-Americans, and intermediate among Latinos, Pacific Islanders, and whites. These inequalities in dementia incidence were observed among women and men and across all ages. Adjustment for comorbidities and health care utilization did not substantially explain differences in dementia incidence. Estimated cumulative incidence of dementia over 25 years was high for all groups. This study provides the most comprehensive view of racial/ethnic inequalities in dementia risk to date.

Prior evidence on racial/ethnic disparities in dementia incidence has relied heavily on comparisons of dementia rates across studies. Because dementia rates are extremely sensitive to diagnostic criteria adopted in each study [9] and geographic patterns may also cause differences across studies [11], it has been difficult to establish the magnitude of racial/ethnic inequalities in dementia incidence. The results of the present study substantiate findings from prior studies with dementia incidence estimates for African-

Americans, Mexican Americans, and Japanese Americans. Most research on disparities in dementia incidence has focused on African-Americans and whites. These studies suggest dementia risk is up to twice as high among African-Americans compared with whites [5,12–14]. African-Americans experienced the highest dementia rates of the racial/ethnic groups included in this study and had approximately 40% higher dementia risk compared with whites, which is more modest than the estimated disparity in some prior studies [12,13] and similar to disparities estimated in other prior work [5,14]. Among Latinos, prior studies suggest dementia risk differs between Latino subgroups, with elevated risk among Caribbean Latinos in New York City [12] but not among Mexican Americans in California [16,33] compared with whites. Evidence from Hispanic/Latino Hispanic Community Health Study/Study of Latinos (HCHS/SOL) provides additional evidence that dementia risk likely varies markedly across Latino
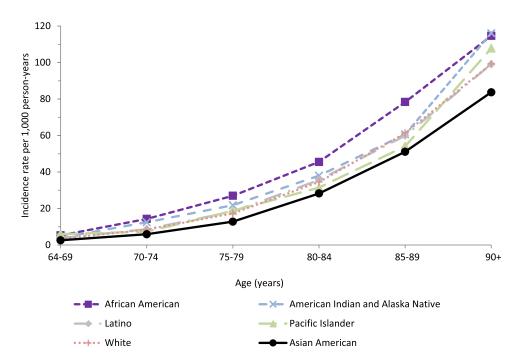

Fig. 2. Dementia incidence rates per 1000 person-years by age and race-ethnicity, 2000–2013.

Table 3
Dementia incidence by race/ethnicity and sex, 2000–2013

Race/ethnicity	Events	Person-years	Age-adjusted incidence rate per 1000 person-years (95% CI)	Hazard ratio (95% CI)		
				Model 1	Model 2	Model 3
Female						
African-American	2921	89,670	26.29 (25.29–27.28)	1.60 (1.51–1.69)	1.60 (1.51–1.69)	1.50 (1.42–1.58)
American Indian and Alaska Native	711	22,920	22.17 (20.42–23.92)	1.35 (1.24–1.46)	1.34 (1.23–1.45)	1.24 (1.14–1.35)
Latino	2497	106,277	20.14 (19.32–20.97)	1.26 (1.19–1.33)	1.25 (1.18–1.32)	1.19 (1.12–1.26)
Pacific Islander	29	1798	17.67 (10.74–24.59)	1.03 (0.72–1.49)	1.04 (0.72–1.51)	0.98 (0.68–1.42)
White	27,070	984,055	19.71 (19.46–19.97)	1.20 (1.15–1.25)	1.19 (1.14–1.25)	1.16 (1.11–1.21)
Asian-American	2219	122,844	16.03 (15.33–16.73)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Male						
African-American	2021	67,448	27.05 (25.82–28.28)	1.93 (1.81–2.06)	1.93 (1.81–2.06)	1.88 (1.76–2.01)
American Indian and Alaska Native	513	18,261	21.98 (19.93–24.03)	1.54 (1.40–1.71)	1.53 (1.39–1.69)	1.45 (1.31–1.60)
Latino	1874	89,409	18.87 (17.96–19.78)	1.34 (1.25–1.43)	1.34 (1.25–1.43)	1.31 (1.23–1.40)
Pacific Islander	32	1447	23.08 (14.95–31.22)	1.58 (1.12–2.25)	1.63 (1.15–2.31)	1.58 (1.12–2.25)
White	18,040	766,197	18.76 (18.47–19.05)	1.33 (1.26–1.40)	1.32 (1.25–1.39)	1.29 (1.23–1.36)
Asian-American	1628	101,276	14.29 (13.56–15.02)	1.00 (ref)	1.00 (ref)	1.00 (ref)

Abbreviations: CI, confidence interval; ref, reference.

NOTE. Age-adjusted dementia incidence rates use 2000 US Census as standard. Hazard ratios for dementia are from sex-specific Cox proportional hazards models. Model 1: adjusted for age (as timescale); model 2: model 1 + health care utilization ($\geq$1 health care visit per year); and model 3: model 2 + depression, diabetes, hypertension, stroke, and cardiovascular disease. P values for multiplicative interaction terms between race/ethnicity and sex from a pooled-sex model adjusted for age (as timescale) to test whether racial inequalities in dementia incidence differ by sex: African-American versus Asian-American $P < .001$; American Indian Alaska Native versus Asian-American $P = .043$; Latino versus Asian-American $P = .141$; Pacific Islander versus Asian-American $P = .097$; and white versus Asian-American $P = .003$.

subgroups in the United States: neurocognitive test performance varied significantly across Latino subgroups in HCHS/SOL, with significantly higher odds of low performance on a neuropsychological test battery among Dominican and Puerto Rican than Mexican origin participants [34]. Although HCHS/SOL did not assess dementia, low performance on neuropsychological tests in population samples strongly predicts future dementia risk [35]. Mexican Americans are the predominant Latino group represented in the present California-based study and make up over 60% of the Latino population in the United States [36]. Our study supports prior evidence suggesting similar dementia rates among Mexican Americans and whites [16,33]. To our knowledge, the only work examining dementia incidence among Asian-Americans has been conducted in Japanese American cohorts. A study of Japanese American men in Hawaii and a study of Japanese Americans in Washington reported similar or lower dementia incidence among Japanese Americans compared with dementia incidence among whites in other studies [17,18]. The low incidence of dementia among Asian-Americans in the present study corroborates these prior findings.

To our knowledge, no prior population-based studies examine dementia incidence among Pacific Islanders or AIANs. Our findings differ from the limited research on dementia in these populations. A recent hospital-based study estimated higher dementia rates among Native Hawaiians and Japanese Americans compared with whites in Hawaii [37]. A small cross-sectional study reported low prevalence of dementia among Cree living on reservations in northern Manitoba, Canada [38]. Differences in our results compared with these prior studies may reflect differences in study

design or true variations in dementia rates among these diverse groups in different geographic locations. The patterning of social, behavioral, and clinical risk factors for dementia may be distinct in Hawaii and Canadian First Nations reservations compared with northern California.

Racial/ethnic inequalities are widely observed for many health outcomes, and hypothesized explanations for inequalities include socioeconomic disparities, psychosocial pathways related to discrimination, behavioral norms, comorbidities, and genetic profiles. In the case of dementia, the most compelling explanations relate to established risk factors for dementia, such as education and vascular comorbidities [8,39]. In two prior population-based studies in the United States, racial/ethnic differences in dementia incidence were substantially explained by literacy (a marker of quality of education) and comprehensive measures of socioeconomic status [5,6]. However, the patterns we report defy simple explanations. Although vascular disease is an appealing explanation for elevated dementia risk in African-Americans, the observed racial/ethnic inequalities in dementia incidence remained after adjustment for vascular comorbidities. Prior studies have demonstrated that associations between midlife vascular risk factors and late-life dementia risk are stronger than associations for vascular risk factors measured in late-life [26,40–42]. Differences in midlife vascular comorbidities may help explain the observed racial/ethnic disparities in dementia. We did not have measures of education in the present study, but educational patterns among older Californians do not strictly follow the observed patterns of dementia risk. For example, whites have the highest average education levels, whereas Latinos have the lowest

(authors' calculations from California Health Interview Survey [43]). There is currently substantial uncertainty on the relative importance of genetic differences in explaining racial/ethnic patterns in dementia [5]. For example, the prevalence of the *APOE* ε4 allele is higher among African-Americans than among whites, but the relative risk of dementia associated with the ε4 allele is smaller among African-Americans compared with whites [14,44–47]. The fact that we observe these disparities in this population with equal health care access indicates access to health care in late-life cannot eliminate disparities in dementia incidence. This supports the need for characterization of life course risk factors [8] to unravel the sources of disparities and identify strategies to eliminate them.

Because mortality is strongly patterned by race/ethnicity, selective survival may contribute to patterns of dementia incidence. However, the patterns we observed were consistent across age groups, and African-Americans and AIANs have notably higher mortality rates compared with Asian-Americans [19]. Thus, selective survival would likely attenuate, rather than explain, the observed racial/ethnic patterns in dementia incidence. Selective survival is a likely explanation for why dementia incidence rates were slightly higher among women than men at ages 90+ in some racial/ethnic groups [48].

The most salient limitation in this study is reliance on clinical diagnosis of dementia from medical records and lack of neuroimaging or postmortem pathology. Given cultural differences in expectations for healthy aging and the potential for differential underdiagnosis by clinicians, it is possible there were differences in diagnosis patterns by race/ethnicity, which could contribute to observed trends, including low incidence of dementia among Asian-Americans. Some studies have reported later and more missed diagnoses in African-Americans [49] and Latinos in southern California [50] compared with whites. Most members in our cohort had regular contact with the health care system, which may mitigate this potential source of bias. Dementia incidence was highest in African-Americans, and if there was underdiagnosis in this group, we could be underestimating the burden of dementia in this group. Ensuring consistency of diagnostic criteria is an important challenge for the field of dementia research, given concerns that even very comprehensive neuropsychological batteries are sensitive to educational and cultural differences [9,10]. Regular standardized dementia screening of all older health plan members, as is commonly used in cohort studies, could provide one approach to partially address this challenge, but such a protocol was not implemented. Neuroimaging measures could provide another approach to partially address this challenge and help distinguish more specific dementia phenotypes (e.g., Alzheimer's disease vs. vascular dementia), but neuroimaging was not available for this cohort. An additional limitation in our approach is that, although our study provides more detailed racial/ethnic patterns than any previous population-based cohort,

we nonetheless combine diverse individuals within broad groups, such as Asian-American or Latino. Exploring potential heterogeneity in dementia risk between subgroups within these broad categories is an important future research step. Another limitation is that health care utilization and censoring due to end of health plan membership were slightly higher among Pacific Islanders than other racial/ethnic groups; we do not know if this censoring is related to dementia risk, but it could influence dementia incidence estimates for this group. Finally, although we assessed whether proximal risk factors for dementia explained observed racial/ethnic inequalities, we could not examine whether these differences remain after adjustment for education, socioeconomic status, and *APOE* genotype.

This study is the first to directly compare dementia incidence in six racial/ethnic groups and the first population-based study to examine dementia incidence among AIANs and Pacific Islanders. The stability of membership among KPNC members allowed us to follow members for incidence of dementia over a prolonged period, with a substantial washout period to ensure we identified incident cases. The population is representative of the community, rather than recruited from selected clinics or volunteers, making our results generalizable to the geographic region of northern California.

In a longitudinal study of health care members with nearly 60,000 incident dementia cases, we observed major racial/ethnic inequalities in dementia incidence, with highest risk among African-Americans and AIANs, lowest risk among Asian-Americans, and intermediate risk among Latinos, Pacific Islanders, and whites. Adjustment for comorbidities did not account for these differences. Cumulative incidence rates indicate that, in every racial/ethnic group, over one in four individuals who survive to age 65 can expect to be diagnosed with dementia. Reducing dementia rates in all racial/ethnic groups to rates observed among Asian-Americans would prevent more than 190,000 dementia cases annually in the United States and have a major public health impact. These findings demonstrate that there are major inequalities in dementia incidence and provide a benchmark for progress toward the NAPA goal of decreasing disparities [1]. It is unclear if these differences are due to genetic or social and behavior factors, but if social and behavior factors are the primary pathways, these findings suggest substantial reductions in dementia incidence are possible. Critical next steps include identifying life course determinants of the observed disparities, examining the correspondence of disparities in dementia incidence with neuroimaging measures, evaluating heterogeneity within racial/ethnic groups, and examining dementia outcomes after diagnosis.

Acknowledgments

Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jalz.2015.12.007.

RESEARCH IN CONTEXT

1. Systematic review: In a literature review using PubMed, most studies on racial/ethnic inequalities in dementia included only 1–2 racial/ethnic groups, for example, only whites and African-Americans. Dementia studies within a single sample representing the full racial/ethnic diversity of the United States are needed.

2. Interpretation: We found marked racial/ethnic disparities in dementia incidence, with highest rates among African-Americans, American Indians and Alaska Natives, lowest rates among Asian-Americans, and intermediate rates among Latinos, Pacific Islanders, and whites. It is unclear if these differences are due to genetic or social and behavioral factors; if social and behavioral factors are primary pathways, these findings suggest substantial reductions in dementia incidence are possible.

3. Future directions: Future research is needed to identify life course determinants of the observed disparities, examine the correspondence of disparities in dementia incidence with neuroimaging measures, evaluate heterogeneity within racial/ethnic groups, and examine dementia outcomes after diagnosis.

References

[1] US Department of Health and Human Services. National plan to address Alzheimer's disease: 2014 update. Available at http://aspe.hhs.gov/daltcp/napa/NatlPlan2014.shtml. Accessed January 17, 2017.

[2] Montine TJ, Koroshetz WJ, Babcock D, Dickson DW, Galpern WR, Glymour MM, et al. Recommendations of the Alzheimer's disease–related dementias conference. Neurology 2014;83:851–60.

[3] Lines LM, Wiener JM. Racial and ethnic disparities in Alzheimer's disease: A literature review, 2014. U.S. Department of Health and Human Services. Available at: https://aspe.hhs.gov/report/racial-and-ethnic-disparities-alzheimers-disease-literature-review. Accessed January 17, 2016.

[4] Alzheimer's Association. 2015 Alzheimer's disease facts and figures. Alzheimers Dement 2015;11:332–84.

[5] Yaffe K, Falvey C, Harris TB, Newman A, Satterfield S, Koster A, et al. Effect of socioeconomic disparities on incidence of dementia among biracial older adults: Prospective study. BMJ 2013;347:f7051.

[6] Byrd DA, Sanchez D, Manly JJ. Neuropsychological test performance among Caribbean-born and US-born African American elderly: The role of age, education and reading level. J Clin Exp Neuropsychol 2005;27:1056–69.

[7] Meng X, D'Arcy C. Education and dementia in the context of the cognitive reserve hypothesis: A systematic review with meta-analyses and qualitative analyses. PLoS One 2012;7:e38268.

[8] Glymour MM, Manly JJ. Lifecourse social conditions and racial and ethnic patterns of cognitive aging. Neuropsychol Rev 2008; 18:223–54.

[9] Erkinjuntti T, Ostbye T, Steenhuis R, Hachinski V. The effect of different diagnostic criteria on the prevalence of dementia. N Engl J Med 1997;337:1667–74.

[10] Weuve J, Proust-Lima C, Power MC, Gross AL, Hofer SM, Thiébaut R, et al. Guidelines for reporting methodological challenges and evaluating potential bias in dementia research. Alzheimers Dement 2015;11:1098–109.

[11] Glymour MM, Kosheleva A, Wadley VG, Weiss C, Manly JJ. Geographic distribution of dementia mortality: Elevated mortality rates for black and white Americans by place of birth. Alzheimer Dis Assoc Disord 2011;25:196–202.

[12] Tang MX, Cross P, Andrews H, Jacobs D, Small S, Bell K, et al. Incidence of AD in African-Americans, Caribbean Hispanics, and Caucasians in northern Manhattan. Neurology 2001;56:49–56.

[13] Shadlen MF, Siscovick D, Fitzpatrick AL, Dulberg C, Kuller LH, Jackson S. Education, cognitive test scores, and black-white differences in dementia risk. J Am Geriatr Soc 2006;54:898–905.

[14] Evans DA, Bennett DA, Wilson RS, Bienias JL, Morris MC, Scherr PA, et al. Incidence of Alzheimer disease in a biracial urban community: Relation to apolipoprotein E allele status. Arch Neurol 2003;60:185–9.

[15] Plassman BL, Langa KM, Fisher GG, Heeringa SG, Weir DR, Ofstedal MB, et al. Prevalence of dementia in the United States: The aging, demographics, and memory study. Neuroepidemiology 2007; 29:125.

[16] Haan MN, Mungas DM, Gonzalez HM, Ortiz TA, Acharya A, Jagust WJ. Prevalence of dementia in older Latinos: The influence of type 2 diabetes mellitus, stroke and genetic factors. J Am Geriatr Soc 2003;51:169–77.

[17] White L, Petrovitch H, Ross GW, Masaki KH, Abbott RD, Teng EL, et al. Prevalence of dementia in older Japanese-American men in Hawaii: The Honolulu-Asia aging study. JAMA 1996;276:955–60.

[18] Borenstein AR, Wu Y, Bowen JD, McCormick WC, Uomoto J, McCurry SM, et al. Incidence rates of dementia, Alzheimer disease, and vascular dementia in the Japanese American population in Seattle, WA: The Kame Project. Alzheimer Dis Assoc Disord 2014;28:23–9.

[19] Hummer RA, Benjamins MR, Rogers RG. Racial and ethnic disparities in health and mortality among the U.S. elderly population. In: Anderson N, Bulatao R, Cohen B, eds. Critical perspectives on racial and ethnic differences in health in late life. Washington D.C.: National Academies Press; 2004. p.53.

[20] Gordon NP, Kaplan GA. Some evidence refuting the HMO "favorable selection" hypothesis: The case of Kaiser Permanente. Adv Health Econ Health Serv Res 1991;12:19–39.

[21] Krieger N. Overcoming the absence of socioeconomic data in medical records: Validation and application of a census-based methodology. Am J Public Health 1992;82:703–10.

[22] Gordon NP. Similarity of the Kaiser Permanente senior member population in northern California to the non-Kaiser Permanente covered and general population of seniors in northern California: Statistics from the 2009 California Health Interview Survey. Oakland, CA: Kaiser Permanente Northern California Division of Research; 2012.

[23] UCLA Center for Health Policy Research. 2001 California Health Interview Survey. Los Angeles, CA.

[24] Whitmer RA, Karter AJ, Yaffe K, Quesenberry CP Jr, Selby JV. Hypoglycemic episodes and risk of dementia in older patients with type 2 diabetes mellitus. JAMA 2009;301:1565–72.

[25] Mayeda ER, Karter AJ, Huang ES, Moffet HH, Haan MN, Whitmer RA. Racial/ethnic differences in dementia risk among older type 2 diabetic patients: The diabetes and aging study. Diabetes care 2014;37:1009–15.

[26] Whitmer R, Sidney S, Selby J, Johnston SC, Yaffe K. Midlife cardiovascular risk factors and risk of dementia in late life. Neurology 2005; 64:277–81.

[27] Exalto LG, Biessels GJ, Karter AJ, Huang ES, Katon WJ, Minkoff JR, et al. Risk score for prediction of 10 year dementia risk in individuals with type 2 diabetes: A cohort study. Lancet Diabetes Endocrinol 2013;1:183–90.

[28] Katon WJ, Lin EH, Williams LH, Ciechanowski P, Heckbert SR, Ludman E, et al. Comorbid depression is associated with an increased risk of dementia diagnosis in patients with diabetes: A prospective cohort study. J Gen Intern Med 2010;25:423–9.

[29] Taylor DH, Fillenbaum GG, Ezell ME. The accuracy of Medicare claims data in identifying Alzheimer's disease. J Clin Epidemiol 2002;55:929–37.

[30] Huang ES, Laiteerapong N, Liu JY, John PM, Moffet HH, Karter AJ. Rates of complications and mortality in older patients with diabetes mellitus: The diabetes and aging study. JAMA Intern Med 2014; 174:251–8.

[31] Julious SA. Using confidence intervals around individual means to assess statistical significance between two means. Pharm Stat 2004; 3:217–22.

[32] Beiser A, D'Agostino RB, Seshadri S, Sullivan LM, Wolf PA. Computing estimates of incidence, including lifetime risk: Alzheimer's disease in the Framingham Study. The Practical Incidence Estimators (PIE) macro. Stat Med 2000;19:1495–522.

[33] Haan MN, Miller JW, Aiello AE, Whitmer RA, Jagust WJ, Mungas DM, et al. Homocysteine, B vitamins, and the incidence of dementia and cognitive impairment: Results from the Sacramento Area Latino Study on Aging. Am J Clin Nutr 2007;85:511–7.

[34] Gonzalez HM, Tarraf W, Gouskova N, Gallo LC, Penedo FJ, Davis SM, et al. Neurocognitive function among middle-aged and older Hispanic/Latinos: Results from the Hispanic Community Health Study/Study of Latinos. Arch Clin Neuropsychol 2015;30:68–77.

[35] Elias MF, Beiser A, Wolf PA, Au R, White RF, D'Agostino RB. The preclinical phase of Alzheimer disease: A 22-year prospective study of the Framingham Cohort. Arch Neurol 2000;57:808–13.

[36] Ennis SR, Rios-Vargas M, Albert NG. This Hispanic population: 2010. 2010 Census Briefs. Washington, D.C.: US Department of Commerce, Economics, and Statistics Administration, US Census Bureau; 2011.

[37] Sentell TL, Valcour N, Ahn HJ, Miyamura J, Nakamoto B, Chow D, et al. High rates of native hawaiian and older Japanese adults hospitalized with dementia in Hawaii. J Am Geriatr Soc 2015;63:158–64.

[38] Hendrie HC, Hall KS, Pillay N, Rodgers D, Prince C, Norton J, et al. Alzheimer's disease is rare in Cree. Int Psychogeriatr 1993;5:5–14.

[39] Barnes DE, Yaffe K. The projected effect of risk factor reduction on Alzheimer's disease prevalence. Lancet Neurol 2011;10:819–28.

[40] Kivipelto M, Helkala EL, Laakso MP, Hänninen T, Hallikainen M, Alhainen K, et al. Midlife vascular risk factors and Alzheimer's disease in later life: Longitudinal, population based study. BMJ 2001; 322:1447–51.

[41] Debette S, Seshadri S, Beiser A, Au R, Himali JJ, Palumbo C, et al. Midlife vascular risk factor exposure accelerates structural brain aging and cognitive decline. Neurology 2011;77:461–8.

[42] Gorelick PB, Scuteri A, Black SE, DeCarli C, Greenberg SM, Iadecola C, et al. Vascular contributions to cognitive impairment and dementia a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke 2011; 42:2672–713.

[43] UCLA Center for Health Policy Research. 2011-2012 California Health Interview Survey. Los Angeles, CA.

[44] Burchard EG, Ziv E, Coyle N, Gomez SL, Tang H, Karter AJ, et al. The importance of race and ethnic background in biomedical research and clinical practice. N Engl J Med 2003;348:1170–5.

[45] Tang MX, Stern Y, Marder K, Bell K, Gurland B, Lantigua R, et al. The APOE-ϵ 4 allele and the risk of Alzheimer disease among African Americans, whites, and Hispanics. JAMA 1998;279:751–5.

[46] Maestre G, Ottman R, Stern Y, Gurland B, Chun M, Tang MX, et al. Apolipoprotein E and Alzheimer's disease: Ethnic variation in genotypic risks. Ann Neurol 1995;37:254–9.

[47] Marden JR, Walter S, Tchetgen Tchetgen EJ, Kawachi I, Glymour MM. Validation of a polygenic risk score for dementia in black and white individuals. Brain Behav 2014;4:687–97.

[48] Chêne G, Beiser A, Au R, Preis SR, Wolf PA, Dufouil C, et al. Gender and incidence of dementia in the Framingham Heart Study from mid-adult life. Alzheimers Dement 2015;11:310–20.

[49] Clark PC, Kutner NG, Goldstein FC, Peterson-Hazen S, Garner V, Zhang R, et al. Impediments to timely diagnosis of Alzheimer's disease in African Americans. Journal of the American Geriatrics Society 2005;53:2012–7.

[50] Fitten LJ, Ortiz F, Pontón M. Frequency of Alzheimer's disease and other dementias in a community outreach sample of Hispanics. Journal of the American Geriatrics Society 2001;49:1301–8.