AN ABSTRACT OF THE DISSERTATION OF

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Title: Disaggregating Asian American, Native Hawaiian and Pacific Islander Health Data: Cardiovascular Health, Neighborhood Factors, and Socioeconomic Disadvantage Among Older Adults

Abstract approved:

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Cardiovascular disease (CVD) is the leading cause of mortality in the United States (US) and research suggests that CVD morbidity and mortality disproportionately impacts Asian American and Native Hawaiian and Pacific Islander (NHPI) older adults. However, the prevalence on CVD and underlying mechanisms for CVD disparities among disaggregated Asian American and NHPI ethnic groups is not well known. Research has demonstrated the association between socioeconomically deprived neighborhoods and higher CVD mortality. Health-related quality of life (HRQOL) and neighborhood socioeconomic factors may help explain discrepant CVD rates across this diverse population. Guided by the ecosocial theory and theory of health services utilization, this dissertation is composed of three empirical papers on CVD among Asian American and NHPI older adults.

The first paper examined the prevalence and determinants of CVD risk factors (obesity, diabetes, smoking status and hypertension) and CVD conditions (coronary artery disease, congestive heart failure, myocardial infarction, other heart conditions,

and stroke) among 10 disaggregated Asian American and NHPI ethnic groups and white adults. Data were from the 2011-2015 Medicare Health Outcomes Survey (HOS), a panel survey of adults aged 65 and older enrolled in Medicare Advantage health plans. The prevalence of overweight and obesity, diabetes and hypertension was higher among most Asian American and NHPI ethnic groups than white adults. There was substantial variation in the prevalence of CVD risk factors across ethnic groups. After adjustment, the majority of Asian American ethnic groups had lower odds of all CVD conditions compared to their white counterparts.

The second paper assessed the relationship between CVD and HRQOL among 10 disaggregated Asian American and NHPI ethnic groups compared to white adults. Data were from the 2011-2015 Medicare HOS. Overall, adults who self-reported a CVD condition had worse physical health and worse mental health than adults without CVD. There were marked differences in physical and mental health across disaggregated Asian American and NHPI ethnic groups. After adjustment, compared to white adults, Asian American and NHPI ethnic groups had better physical health but worse mental, though the differences were not statistically significant for all ethnic groups. Furthermore, race/ethnicity moderated the relationship between CVD and HRQOL.

The third paper investigated the relationship between neighborhood socioeconomic disadvantage and CVD in Asian American and NHPI older adults. Data came from the 2011-2015 Medicare HOS and Neighborhood Atlas 2015 US Area Deprivation Index. Neighborhoods were defined as more disadvantaged and less disadvantaged. Overall, about 8% of respondents lived in more disadvantaged

neighborhoods. Respondents living in more disadvantaged neighborhoods reported higher rates of diabetes, hypertension, smoking, and obesity. Residence in more disadvantaged neighborhoods ranged from 2% among Japanese to 22% in Other Pacific Islander adults. Adults residing in more disadvantaged neighborhoods had greater odds of any CVD diagnosis, coronary artery disease, congestive heart failure, other heart conditions, and stroke compared to adults in less disadvantaged neighborhoods. These associations were not statistically significant after adjustment.

Our findings of greater prevalence of overweight and obesity, diabetes and hypertension as well as worse mental health among disaggregated Asian American and NHPI adults suggest there are still improvements to be made in prevention efforts for these groups. These papers highlight the importance of individual- and neighborhood-level factors as possible areas to prevent CVD as well as improve overall well-being for Asian American and NHPI adults in the US.

Disaggregating Asian American, Native Hawaiian and Pacific Islander Health Data: Cardiovascular Health, Neighborhood Factors, and Socioeconomic Disadvantage Among Older Adults

by
Lan N. Đoàn

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Lan N. Đoàn, Author

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CONTRIBUTION OF AUTHORS

Dr. Irvin was involved with the design of and provided feedback on Chapters 2, 3, and 4. Dr. Takata provided statistical guidance on Chapter 2 and provided feedback on Chapters 2, 3, and 4. Dr. Mendez-Luck and Dr. Hooker provided feedback on Chapters 2, 3, and 4.

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DEDICATION

This dissertation is dedicated to my parents –
Tuyết Trần and Trứ Đoàn,
who have stood behind me all the way.

CHAPTER 1. INTRODUCTION

Overview and Context

The burden of cardiovascular disease (CVD) is increasing, and by 2035, projections show that over 45 percent of the total US population will have at least one CVD condition (1,2). While white adults have experienced decreases in CVD mortality between 2003 and 2010, CVD mortality rates have increased for Asian Indian women and have not improved for other Asian American ethnic groups (3). Asian American adults also experience a greater proportionate mortality burden for hypertensive heart disease and cerebrovascular disease compared to white adults (3). Research has demonstrated Native Hawaiians and Pacific Islander (NHPI) populations have higher prevalence of CVD morbidity and mortality than white and Asian American populations (4,5). However, the true magnitude of CVD in disaggregated Asian American and NHPI ethnic groups is poorly understood because of the limited racial/ethnic data collected on these populations. Health-related quality of life (HRQOL) and neighborhood socioeconomic factors may help explain discrepant CVD rates across this diverse population. Guided by the ecosocial theory and theory of health services utilization, this dissertation is composed of three empirical papers on cardiovascular disease disparities among Asian American and NHPI older adults.

Public Health Significance

Asian Americans are the second fastest growing racial/ethnic population, projected to increase by 201% between 2016 to 2060, while the NHPI population is

projected to increase 146% during the same time period (6). Specific to adults aged 65 years and older, Asian Americans are the fastest growing population in the US (7,8). Asian American and NHPI older adults are a particularly vulnerable population as they face the interacting experiences of racial/ethnicity minority group status and older age (9). Most Asian American older adults are foreign-born and arrived in the US as immigrants or refugees (10). Native Hawaiians are federally recognized as indigenous people and other Pacific Islanders were admitted to the US as non-immigrants (11). The majority of Asian American and NHPI older adults have low education levels, limited English proficiency, and high poverty rates (8,12).

Asian American and NHPI populations have distinct cultural and linguistic profiles (13), as well as unique experiences of individual discrimination (e.g., discriminatory experiences based on country of origin and political status) and institutional racism (e.g., health policies for non-immigrants) that impact the health care use and access (14,15). Racial/ethnic minority older adults are underrepresented in research (16–18) and clinical research in Asian American and NHPI populations is underfunded (19). The rapidly growing aging population and increasing racial/ethnic diversity in the US underscores the critical need to understand CVD health in Asian American and NHPI older adults. Accurately illustrating health profiles for Asian American and NHPI adults is necessary to develop appropriate clinical guidelines and culturally-tailored public health interventions, as well as make recommendations for CVD research priorities (20).

National data collection and reporting on CVD morbidity and mortality have typically been limited to white, black or African American, and other racial

categories. (13,21). Where data are reported for Asian American and NHPI populations, there are inconsistencies in how these two racial groups are reported. For instance, prior studies have reported these groups as an aggregate (e.g., Asian/Pacific Islander), as a single racial group (e.g., Asian), or simply do not report on these groups (13). The few studies that have included Asian American and NHPI populations focused on a specific ethnic group, such as the Ni-Hon-San study that included Japanese men in Japan, Hawaii and California (22); Mediators of Atherosclerosis in South Asians Living in America (MASALA) study that included South Asians (Indian, Pakistani, Bangladeshi, Nepali, and Sri Lankan) (23); and Multi-Ethnic Study of Atherosclerosis (MESA) study that included Chinese adults (24). Furthermore, there are few studies examining CVD conditions among adults aged 65 and older that also disaggregate Asian American and NHPI ethnic groups (3,25,26).

The innovation of the dissertation is underscored in three respects. First, the Medicare Health Outcomes Survey (HOS) is a unique dataset that began collecting expanded ethnic and racial data in 2011, which allows disaggregated analysis of 10 Asian American and NHPI ethnic groups. The Medicare HOS has disaggregated data and adequate sample sizes that allows for meaningful analysis of between-group (e.g., white versus Asian Indian) and within-group (e.g., Asian Indian versus Vietnamese) differences. Second, the HOS is the first national survey to measure functional health status and HRQOL in adults enrolled in Medicare Health Advantage plans. To our knowledge, the HOS has not been used to identify the prevalence and determinants of CVD and HRQOL by disaggregated ethnic group. Finally, we examined the

relationship between neighborhood socioeconomic disadvantage and CVD, as a possible neighborhood-lever in future intervention efforts mitigating the burden CVD among Asian American and NHPI adults, as well as other racial/ethnic groups in the US.

Conceptual Framework

The dissertation research was guided by literature reviews (Appendix) and integration of Krieger's ecosocial theory and Andersen and Newman's determinants of medical care utilization (27,28). This conceptual framework was used to provide context on the multilevel factors impacting health care and access to health care resources that subsequently impact CVD outcomes. We did not use all of the constructs of the theories and operationalization constructs based on the availability in the Medicare Health Outcomes Survey and Neighborhood Atlas Area Deprivation Index (ADI). We focused on the historical context over the life course, experiences of individual- and structural-level racism, and determinants of health care utilization. Our conceptual model (Figure 1.1) lists our hypothesized pathways.

The ecosocial theory (29,27) asks the question of who and what is driving social inequalities in health (30) (see figure 1). Ecosocial theory proposes that disease distribution is dynamic and influenced by social and biological relationships (29,31). The four constructs of ecosocial theory are summarized as:

(a) Embodiment: the phenomena of literal biological incorporation of the material and social world across the life course;

(b) Pathways of embodiment (i.e., "trajectories of biological and social development"): life experiences (e.g., economic deprivation, social trauma,

inadequate healthcare) that take into account both social and biological pathways and result in diverse outcomes;

(c) Cumulative interplay among exposure, susceptibility, and resistance across the life course (i.e., timing and accumulation): both social and biological pathways operate at multiple levels (e.g., individual, neighborhood, nation) and domains (e.g., home or work), and across the life course (e.g., exposures at multiple points in time from in utero to death); and

(d) Accountability and agency: knowledge of social disparities in health and responsibility to explain health inequities (27,32).

The ecosocial theory emphasizes that patterns of disease are influenced by biological and psychosocial factors at multiple levels of society (e.g., individual, household, national) and the role of historical context over the life course (27), which influences the individual- and environmental-factors associated with health care utilization and access to health care services. We frame our research using the ecosocial lens to understand the complex profiles of Asian American immigrant and NHPI populations. The ecological framework shifts the focus of understanding health from the individual level to multiple levels of the environment (e.g., individual and neighborhood). The life course timeline allows for the accumulating effects of advantage or disadvantage to be understood for health disparities and aging.

Asian American and NHPIs have different immigration and settlement patterns into the US, which influences where individuals decide to settle and their neighborhood characteristics (11,33). Thus, neighborhood characteristics (e.g., neighborhood socioeconomic status) are related to race/ethnicity and socioeconomic

position (34). The neighborhoods where individuals live influence health service utilization. These neighborhood characteristics could influence the availability to language-concordant or culturally-relevant health care services. For example, if a neighborhood has abundant access to healthcare facilities and personnel, there might be greater usage of services because of greater accessibility. Individual-level factors related to acculturation and immigration could impact health-related behaviors and dietary habits (35) that are enabled or impeded by their neighborhood environments (36).

We used ecosocial theory to conceptualize self-reported race/ethnicity. We operationalize race/ethnicity as a social construct representing the diverse immigration and acculturation experiences of Asian American and NHPI ethnic groups (11,33,35). Each disaggregated racial/ethnic group represents a unique social context that would partially explain differences in CVD. These racial/ethnic categories also represent experiences of racism that impact individual-level discriminatory experiences and access and quality of health care services via neighborhoods (37,38). The ecosocial theory posits that individuals can embody racism through the multiple levels of society and the ecosystem, across the life course and generations, which ultimately leads to an unequal population distribution of health (39).

The individual determinants of utilization was used to further support the pathways to embodiment (e.g., racism) and cumulative interplay among exposure, susceptibility, and resistance across the life course (e.g., neighborhood environments and immigration and acculturation experiences) (28). The main tenets of Andersen

and Newman's theory are that the type and volume of health care use is dependent on: individual characteristics that make them more likely to use services (e.g., predisposing characteristics); resources available to individuals to access health care (e.g., enabling resources); and illness level (e.g., need factors) (28).

The predisposing component is made up of demographic variables, social variables and belief characteristics. The demographic variables are hypothesized to be associated with health and illness, as well as predict the type, amount, and quantity of health service utilization (28). For example, the health utilization patterns of older adults will be different than a young adult. The social variables take into account the social and physical environments, and how it influences behaviors of health service utilization (28). Belief characteristics are individual health behaviors that influence patterns of health service use. The enabling resources are the conditions that made health service resources available to individuals (28). For example, family resources could determine the type and frequency of care as well as access to care (health insurance). Need factors are the most important tenet determining health care utilization (28). Need factors are perceived health and diagnosed health outcomes. The theory of healthcare utilization posits that addressing need would ensure equitable distribution of services, because then health services would not be distributed based on predisposing or enabling components (i.e., race, ethnicity, or geographic location) (28).

Specific Aims

This dissertation had two overarching goals: (1) to characterize the heterogeneity of CVD risk factors and CVD conditions in disaggregated Asian American and NHPI ethnic groups; and (2) understand the effects of neighborhood-level characteristics on CVD outcomes. These goals are aligned with the National Institute on Aging (NIA) "to understand health disparities and develop strategies to improve the health status of older adults in diverse populations" (40). Although some research has examined the CVD among Asian American and NHPI adults, CVD risk factors and CVD conditions by disaggregated Asian American and NHPI ethnic groups is poorly understood and remains relatively unexplored. We used the 2011-2015 Medicare Health Outcomes Survey (HOS), an annual survey administered by the Centers for Medicare & Medicaid Services, and 2015 Neighborhood Atlas, an online tool that provides scores measuring neighborhood socioeconomic disadvantage, to complete the dissertation aims. This dissertation research aimed to:

Aim 1: Identify the prevalence and determinants of cardiovascular disease (CVD) in disaggregated Asian American and NHPI ethnic groups compared to white adults.

- Hypothesis 1a: There will be heterogeneity in CVD by Asian American and NHPI ethnic group.
- Hypothesis 1b: Among Asian American and NHPI older adults, limited English proficiency will be associated with an increased risk of CVD.
- Hypothesis 1c: Asian American and NHPI adults will have greater prevalence of CVD compared to white adults.

Aim 2: Assess the associations between CVD health and HRQOL among disaggregated Asian American and NHPI ethnic groups compared to white adults.

- Hypothesis 2a: Adults who report CVD will have worse HRQOL compared to adults without CVD.
- Hypothesis 2b: Among Asian American and NHPI adults with CVD, there will be differences in HRQOL (e.g., physical and mental health) across ethnic groups.
- Hypothesis 2c: Asian American and NHPI adults with CVD will have worse HRQOL compared to white adults with CVD.

Aim 3: Determine the associations between neighborhood-level characteristics and individual-level CVD among disaggregated Asian American and NHPI ethnic groups.

- Hypothesis 3a: Adults living in more disadvantaged neighborhoods will have increased risk of CVD compared to adults living in less disadvantaged neighborhoods.

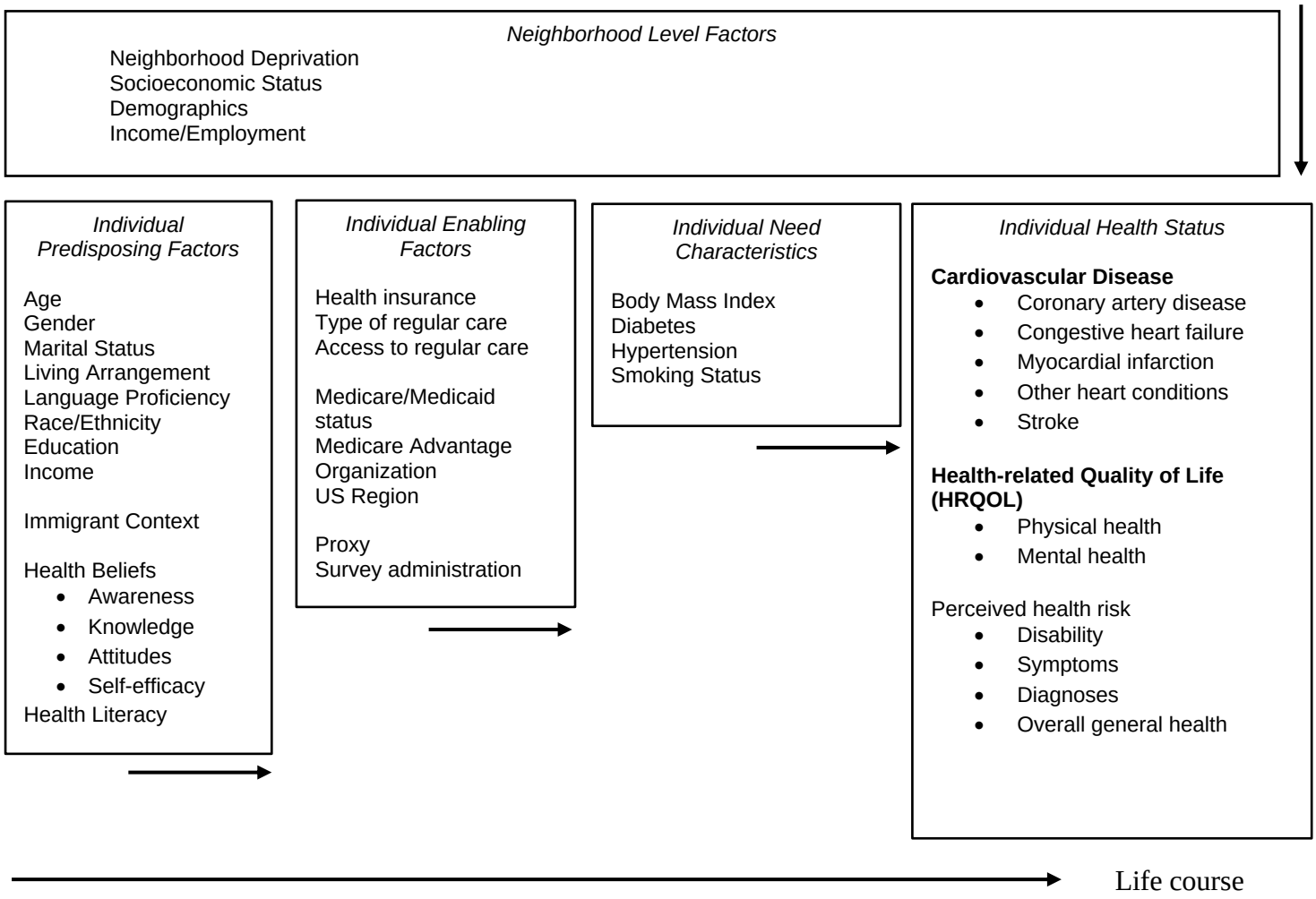
The dissertation will characterize the heterogeneity of CVD risk factors and CVD conditions, as well as identify high risk groups, among Asian American and NHPI ethnic groups. This dissertation will also assess how self-reported CVD is impacted by the intersections of neighborhoods and race/ethnicity. This research informs our understanding of the current burden of CVD among Asian American and NHPI older adults and potential areas to focus individual- and neighborhood- level prevention efforts. This dissertation serves as an initial step to inform culturally- and linguistically-relevant prevention and treatment strategies for Asian American and

NHPI populations. This research may provide insights on the role of neighborhood socioeconomic environments in shaping the CVD burden.

Dissertation Structure

This dissertation is composed of three papers that examine CVD health disparities among Asian American and Native Hawaiian and Pacific Islander (NHPI) older adults and was structured as follows. Specific aims 1, 2, and 3 are presented in Chapters 2, 3, and 4, respectively. Chapter 2 presents the manuscript on the prevalence and determinants of CVD risk factors and CVD conditions among Asian American and NHPI ethnic groups and white adults. Chapter 3 presents the manuscript assessing the relationship between CVD conditions and HRQOL among Asian American and NHPI ethnic groups and white adults. Chapter 4 presents the final paper investigating the relationship between neighborhood socioeconomic disadvantage on CVD conditions among Asian American and NHPI ethnic groups. Chapter 5 provides concluding remarks regarding the overall findings of the dissertation, broader limitations, and directions for future research. Each chapter examined the extent to which CVD differed by Asian American and NHPI ethnic group. The Appendix includes a broad literature of prior research on CVD conditions, CVD risk factors and neighborhood environments in Asian American and NHPI populations.

Figure 1.1. Conceptual Framework



CHAPTER 2. FIRST MANUSCRIPT

Trends in Cardiovascular Disease by Asian American and Native Hawaiian and Pacific Islander Ethnicity, Medicare Health Outcomes Survey 2011-2015

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ABSTRACT

Background: The burden of cardiovascular disease (CVD) is increasing in the aging population. Research to understand CVD health by disaggregated ethnic groups among older Asian American and Native Hawaiians and Pacific Islander (NHPI) adults is sparse. This study examined the prevalence and determinants of CVD risk factors and CVD among 10 disaggregated Asian American and NHPI ethnic groups and white adults.

Methods: Data were from the Centers for Medicare & Medicaid Services 2011-2015 Medicare Health Outcomes Survey, which started collecting expanded racial/ethnic data in 2011. Multivariable logistic regression analyses were conducted to examine the prevalence and determinants of CVD risk factors (obesity, diabetes, smoking status and hypertension) and CVD conditions (coronary artery disease [CAD], congestive heart failure [CHF], myocardial infarction [MI], other heart conditions, and stroke). The analytic sample was 639,862 respondents, including 26,853 Asian American and 4,926 NHPI adults.

Results: The prevalence of overweight and obesity, diabetes and hypertension was higher among most Asian American and NHPI ethnic groups than white adults. There was substantial variation in the prevalence of CVD risk factors across Asian American and NHPI ethnic groups. Among the total sample, 13% reported CAD, 7% reported CHF, 10% reported MI, 22% reported other heart conditions, and 7% reported stroke. After adjustment, most Asian American and NHPI ethnic groups had lower odds of all CVD conditions than white adults.

Conclusions: More attention should be focused on NHPI groups as a priority population based on the disproportionately higher rates of CVD risk factors compared to their white and Asian American counterparts. Future research should disaggregate racial/ethnic group information to provide accurate depictions of CVD health and investigate the development of CVD risk factors in Asian American and NHPI adults over the life course.

Introduction

The burden of cardiovascular disease (CVD) is increasing, and by 2035, projections show that over 45 percent of the total US population will have at least one CVD condition (1,2). Total costs associated with CVD will be $1.1 trillion dollars (2). CVD is the leading cause of mortality in the United States (US), including for adults aged 65 and older (41,42).

While white adults have experienced decreases in CVD mortality between 2003 and 2010, CVD mortality rates have increased for Asian Indian women and have not improved for other Asian American ethnic groups (3). Asian American adults also experience a greater proportionate mortality burden for hypertensive heart disease and cerebrovascular disease compared to white adults (3). Similarly, Iyer et al. (2019) reported variation in premature mortality (i.e., death at younger age) due to cardiovascular disease and longer years of life lost because of cerebrovascular disease in Asian Americans compared to whites (43). Furthermore, research has demonstrated Native Hawaiians and Pacific Islander (NHPI) populations have higher prevalence of CVD morbidity and mortality than white and Asian American populations (4,5).

Asian Americans are the second fastest growing racial/ethnic population, projected to increase by 201% between 2016 to 2060, while the NHPI population is projected to increase 146% during the same time period (6). Specific to adults aged 65 years and older, Asian Americans are the fastest growing population in the US (7,8). While much research combines Asian American and NHPI, these categories represent two distinct racial categories (44), and collectively represent more than 40 communities and countries of origin that speak 100 different dialects and languages

(13). Asian Americans typically arrived in the US as immigrants or refugees (10). In contrast, Native Hawaiians are federally recognized as indigenous people (e.g., similar to American Indians and Alaskan Natives), but other Pacific Islanders have different political relationships with the US (e.g., citizens from the Federated States of Micronesia, Republic of the Marshall Islands, and Republic of Palau were admitted to the US as non-immigrants) (11). Asian American and NHPI populations also have unique profiles of individual discrimination (e.g., discriminatory experiences based on country of origin and political status) and institutional racism (e.g., health policies for non-immigrants) that impact health care utilization and access (14,15).

Despite the aforementioned differences, data for Asian American and NHPI populations are typically reported as an aggregate or not reported. This reporting practice is still common even after the 1997 Office of Management and Budget's (OMB) standards required more detailed federal reporting on racial/ethnic groups (44). For example, the Centers for Disease Control and Prevention (CDC) (41,42) and Health People 2020 (45) report CVD data for non-Hispanic Asian or Pacific Islanders combined. Reporting the racial groups together results in misleading characterizations of health and health outcomes because it ignores variability across Asian American and NHPI ethnic groups and subsequently impacts the ability to develop appropriate guidelines and interventions for CVD research for Asian American and NHPI populations (20,21,46).

Given the heterogeneity of Asian American and NHPI populations, the American Heart Association issued a call to action for CVD research among Asian Americans in 2010 (20). Research indicates that the prevalence of CVD risk factors

are unequally distributed across Asian American and NHPI groups (20). For example, studies have reported higher rates of hypertension among Filipino adults than other Asian American groups, and higher total cholesterol among Japanese adults than Chinese adults (20). Another study on smoking prevalence reported differences based on ethnicity and gender, with the highest smoking prevalence among Korean and Vietnamese men, compared to other Asian American groups (47). Among NHPI groups, there is consensus in the literature that Native Hawaiians have among the highest rates of obesity, diabetes, smoking, hypertension, and high cholesterol, compared to whites and other racial/ethnic groups (48). These differences across Asian American and NHPI groups could be attributable to acculturation factors (e.g., lifestyle changes) or political status (e.g., non-immigrants) that subsequently impact health behaviors and health care access (14,15). Additionally, research suggests that the impact of CVD risk factors varies by Asian American and NHPI ethnic group. For example, body fat composition affects one's risk of CVD and Asian Americans have higher percentages of body fat at lower mean and median body mass index (BMI) levels compared with whites. Hence, lower BMI cutoffs are recommended for the definitions of overweight and obesity in Asian Americans (49).

Few studies have examined CVD risk factors and CVD prevalence among Asian American and NHPI older adults by ethnic group. This study describes the prevalence and determinants of CVD risk factors (obesity, diabetes, smoking and hypertension) and self-reported CVD condition (coronary artery disease [CAD], congestive heart failure [CHF], myocardial infarction [MI], other heart conditions,

and stroke) for 10 disaggregated Asian American and NHPI ethnic groups and white adults enrolled in Medicare Advantage health plans.

Methods

Data came from the Centers for Medicare and Medicaid Services (CMS) Health Outcomes Survey (HOS), a nationally representative survey of individuals enrolled in Medicare Advantage plans. About one-third of Medicare beneficiaries are enrolled in Medicare Advantage plans (50). The HOS randomly samples individuals enrolled in Medicare Advantage organizations that have a minimum of 500 members (51). The HOS is a panel survey with baseline cohorts sampled annually, followed by a two-year follow-up. Surveys written in English, Spanish, and Chinese are mailed to adults. Incomplete surveys and non-respondents are contacted by phone up to nine times in English or Spanish. The HOS contains questions about health-related quality of life, chronic medical conditions, activities of daily living, instrumental activities of daily living, and healthcare effectiveness data and information set measures. The patient-reported HOS data are used for quality improvement activities and to monitor health plan performance (51).

We analyzed the five baseline Medicare HOS Limited Data Sets (LDS) cohorts (2011-2015). The HOS began collecting expanded racial/ethnic data in 2011 and includes disaggregated data for seven Asian American and four NHPI categories. We included adults who were 65 years of age or older at baseline and self-identified as Asian American, NHPI, or white. We excluded respondents who were in hospice care, institutionalized, or had end stage renal disease. We also excluded baseline

surveys that were incomplete (i.e., less than 79.5% of the survey was completed). The final analytic sample included 639,862 Medicare Advantage enrollees from 416 plans. The [school] institutional review board determined this study exempt from human subjects research.

Conceptual Framework for Analysis

Our analyses and selection of the model covariates were informed by Andersen and Newman's model of health services utilization (28). The three main factors of this model include predisposing characteristics such as race/ethnicity and age, enabling resources such as income and health insurance, and need characteristics such as perceived and evaluated health status or contextual factors. Predisposing characteristics are antecedent to an outcome and reflect an individual's social position to obtain or impede use of enabling resources. Need characteristics include individual perceptions of need for health services and contextual factors like the availability of health services, that influence individual perceptions of need. We hypothesized that predisposing characteristics, enabling resources, and need characteristics would impact health behaviors, and thus use of and barriers to health care services related to treatment and management of CVD risk factors and CVD conditions.

Dependent Variables

The dependent variables for this analysis included five dichotomous cardiovascular and stroke outcomes. Respondents were asked if a doctor ever diagnosed them with angina pectoris or coronary artery disease; congestive heart failure; a myocardial infarction or heart attack; other heart conditions, such as problems with heart valves or the rhythm of your heartbeat; and stroke.

Primary Independent Variable

The primary independent variable was self-reported race/ethnicity. We hypothesize that differences in CVD health are not due to being members of these social categories, rather that membership in these groups signify differences in the determinants of health that influence disease patterns. We conceptualize race/ethnicity to represent factors like culture, socioeconomic position, political status, and racism that impact acculturation, discriminatory experiences, access and quality of health care services, and ultimately, health status (37,38).

Respondents were asked to self-identify if they were of Hispanic or Latino origin or descent and their race. Individuals who said no to being from Hispanic or Latino origin were categorized as being non-Hispanic. The 11 racial/ethnic categories were: Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian, Multiple race Asian, Native Hawaiian, Other Pacific Islander, and white. Most racial/ethnic groups were non-Hispanic except for Multiple race Asian, who included respondents who self-identified as an Asian group and another racial/ethnic group. Native Hawaiian included all respondents who self-identified as Native Hawaiian, even if they chose another racial/ethnic group. Other Pacific Islander included individuals who identified as Guamanian, Samoan, or Other Pacific Islander. White adults were included in the analyses as the referent group.

Covariates Selection

Andersen and Newman's theoretical framework guided the selection of our covariates that we hypothesized would explain differences in health care access and barriers to health care. We selected predisposing characteristics, enabling resources,

and need factors a priori based on known associations with CVD risk factors and CVD conditions (52) and health disparities among racial/ethnic minority groups (53).

Predisposing characteristics included respondent sex, age (continuous variable), education attainment and marital status. Enabling resources included household income and enrollment in Medicare/Medicaid. Individual need factors included body mass index (BMI), diabetes, hypertension, and current smoking status. Asian-specific BMI thresholds (overweight = 23 – 27.5 kg/m^2, obese ≥ 27.5 kg/m^2) were applied for Asian American respondents, except for Multiple race Asian respondents, based on recommendations from the World Health Organization (WHO) for more clinically relevant BMI thresholds for Asian populations (54). Respondents were asked if a doctor ever diagnosed them with diabetes or hypertension. Current smoking status was categorized as smoking every day, smoking some days, not smoking at all and don't know. Contextual need factors included geographic region of the Medicare Advantage organization, whether or not a proxy had completed the survey, and survey administration year. We included the geographic region adjust for potential differences in health organizations by location. Geographic region was based on the CMS regional offices that each represent Medicare Advantage organizations from several states. The survey year was included to account for biases in survey administration and different HOS survey versions.

Statistical Analysis

All analyses were conducted with RStudio, version 1.1.453 (55). We describe the prevalence of baseline predisposing, enabling, and need characteristics of the full sample by overall racial group and disaggregated racial/ethnic groups. We compared

CVD risk factors and CVD conditions by disaggregated race/ethnicity and sex using one-way analysis of variance (ANOVA) for continuous variables and chi-square test for categorical variables. All study variables compared disaggregated Asian American and NHPI ethnic groups to white adults (referent group). We fit logistic regression models to examine the association between racial/ethnic group and CVD condition, stratified by sex. For each CVD condition, we fit an unadjusted model, model adjusting for age, and full model all of the covariates. We present odds radios (ORs) and 95% confidence intervals (CIs) and a p-value less than 0.05 was considered a statistically significant relationship for the estimates by characteristics and in the multivariate logistic regression models.

We conducted sub analyses to explore the moderating effect of language mainly spoken at home and English proficiency on the association between race/ethnicity and CVD. Respondents were asked how well they spoke English in 2013 and 2014, and the language mainly spoken at home starting in 2015. We hypothesized that Asian American and NHPI ethnic groups who did not speak English at home or who had low levels of English language proficiency would be less likely to use health care services.

Results

Predisposing, Enabling, and Need Characteristics of CVD

Table 2.1 shows predisposing characteristics, enabling resources and contextual need factors of CVD, by total sample and racial/ethnic group. The study variables were all significantly different across Asian American and NHPI ethnic

groups compared to white adults. All Asian American and NHPI ethnic groups except for Japanese reported greater proportion of not graduating from high school, earning an income less than $10,000 and having Medicare/Medicaid coverage than white adults. With the exception of Asian Indian and Other Pacific Islander adults, the majority of Asian American and Native Hawaiian respondents were located in the San Francisco region and all Asian and NHPI ethnic groups were more likely to report having a proxy complete the survey.

Individual Need Factors

Table 2.2 shows the prevalence of CVD risk factors by total sample, race/ethnicity and sex. Most Asian American adults reported greater prevalence of being overweight, diabetes, and hypertension but lower prevalence of smoking compared to white adults. Compared to Asian American men, Asian American women reported lower proportions of being overweight, diabetes and smoking but higher proportions of hypertension. Among Asian American men, Filipino men reported the highest prevalence of being overweight and obese and hypertension; Asian Indian men had greatest prevalence of diabetes; and Multiple race Asian men had the highest prevalence of smoking. Among Asian American women, Asian Indian women reported the highest prevalence of being overweight and obese and diabetes; and Filipino women had greatest prevalence of hypertension; and Multiple race Asian women had the highest prevalence of smoking. The majority of adults in the sample were overweight and had hypertension (Table 2.5).

Compared to white adults and the majority of Asian American groups, NHPI adults reported greater prevalence of obesity, diabetes, hypertension, and smoking.

NHPI women reported greater prevalence of obesity and hypertension but lower prevalence of diabetes and smoking than NHPI men. Among NHPI adults, Other Pacific Islander men and women reported higher proportions of being overweight and obese, diabetes and hypertension whereas Native Hawaiian men and women reported higher proportions of smoking.

Prevalence of CVD conditions and stroke

Table 2.3 shows the prevalence of self-reported CVD conditions and stroke by race/ethnicity and sex. Among the total sample, 13% reported CAD; 7% reported CHF; 10% reported MI; 22% reported other heart conditions; and 7% reported stroke (Table 2.6). Compared to white men, the majority of Asian American men reported lower proportions of CAD, CHF, MI, other heart conditions and stroke, with the exception of Asian Indian men who reported higher CAD proportions and Filipino and Multiple race Asian men who reported higher stroke proportions. Among Asian American men, Asian Indian men reported CAD and MI most often while Multiple race Asian men reported CHF, other heart conditions and stroke most often. Compared to white women, the majority of Asian American women reported lower prevalence of CVD conditions and stroke except for Vietnamese and Multiple race Asian women. Vietnamese reported stroke more often than did white women, whereas Multiple race Asian women reported CAD, CHF, and stroke more often. Among Asian American women, Multiple race Asian women reported the greatest prevalence of all CVD conditions and stroke.

Native Hawaiian men reported the higher proportions CHF, MI, other heart conditions and stroke compared to white men while Other Pacific Islander men

reported greater proportions of CHF and stroke. NHPI women reported higher proportions of CAD, CHF, MI, other heart conditions and stroke than did white women.

Association between race/ethnicity and CVD conditions

In the adjusted analyses, the majority of Asian American ethnic groups and Other Pacific Islanders had significantly lower odds of CAD, CHF, MI, other heart conditions and stroke than did white adults. Native Hawaiian adults had significantly greater odds of reporting stroke than white adults (Table 2.7).

Table 2.4 shows the unadjusted and adjusted associations between CVD conditions and stroke by racial/ethnic group and sex. The majority of Asian American ethnic groups had statistically significant lower odds of all CVD conditions and stroke compared to their white counterparts. There were mixed results among NHPI men and women. Compared to white men, Native Hawaiian men had significantly greater odds of CHF and stroke while Other Pacific Islander men had significantly lower odds of all CVD conditions and stroke. Native Hawaiian women had significantly lower odds of other heart conditions but greater odds of stroke than white women, and Other Pacific Islander women had significantly lower odds of all CVD conditions and stroke.

Association of CVD risk factors and CVD conditions

We also examined the association between CVD risk factors and CVD conditions and stroke. In the adjusted model, diagnoses of hypertension and diabetes and smoking every day and somedays was positively associated with all CVD conditions and stroke. BMI was positively associated with CAD, CHF and MI, such

that underweight, overweight and obese individuals had significantly greater risk of CVD than normal weight individuals. The statistical significance varied for the associations between BMI and other heart conditions and stroke. For instance, underweight and obese adults had greater risk and overweight adults had lower risk of other heart conditions than did normal weight individuals. For stroke, underweight adults had significantly greater risk of stroke than normal weight adults whereas overweight and obese adults had significantly lower risk of stroke.

Association of language spoken and English proficiency with CVD conditions

With the exception of Japanese adults, the majority of Asian American ethnic groups did not speak English at home, with the prevalence ranging from 8% in Japanese to 85% in Vietnamese adults. Among Asian American ethnic groups, low English proficiency (i.e., speaking English well or not at all) ranged from 9% among Japanese to 72% among Vietnamese adults. The majority of Native Hawaiian and Other Pacific Islander adults spoke English at home and were proficient in English. In the analyses adjusting for all covariates, English proficiency and main language spoken at home did not change the relationship between race/ethnicity and CVD conditions and stroke.

Discussion

Our study focused on the CVD risk factors and CVD conditions for Asian American and NHPI older adults to better characterize health of these racial/ethnic minority groups in the US. We analyzed a nationally representative sample of older adults enrolled in Medicare Advantage plans. The HOS data has expanded Asian

American and NHPI racial/ethnic categories, which allowed us to examine CVD risk factors and CVD conditions for disaggregated Asian American and NHPI ethnic groups. We used Andersen and Newman's conceptual framework to frame our research hypotheses around the racialized experiences of Asian American and NHPI older adults to understand the factors influencing health care utilization regarding CVD.

Our study demonstrates that the prevalence of overweight and obesity, diabetes and hypertension (e.g., individual need factors) was higher among most Asian American and NHPI ethnic groups than white adults. Furthermore, we found substantial variation in the prevalence of CVD risk factors across Asian American and NHPI ethnic groups. Our findings that Filipino men and women had greatest prevalence of overweight and obesity and hypertension compared to other Asian American ethnic groups (49,56) and that all Asian American groups had higher prevalence of diabetes compared to white adults (49,57) are consistent with prior research. A possible explanation for our high prevalence of overweight and obesity is that we used the WHO recommended thresholds for overweight and obesity for Asian American groups. Previous research reported that more than half of Chinese, Filipino, Japanese, Korean, and South Asian adults were overweight or obese using the Asian-specific BMI criteria (49). This study also found that diabetes rates were higher among Vietnamese, Koreans, Filipinos and South Asians in the lower BMI thresholds (BMI = 23–24.9 kg/m$_2$) compared to white adults (49). This suggests that the prevalence of diabetes among our sample could be under diagnosed.

Previous research also supports our finding that NHPI adults experience a greater burden of obesity, diabetes, hypertension, and smoking compared to white and Asian American adults (5). We were able to disaggregate the NHPI racial category and observed variation across the ethnic groups, emphasizing the need to collect and report disaggregated racial/ethnic data when possible. For instance, 15% of Native Hawaiian women reported smoking every day or some days compared to Other Pacific Islander women (6%); and 45% of Other Pacific Islander men reported diabetes compared to 37% of Native Hawaiian men. One study reported that CVD mortality was four times higher among Native Hawaiian with diabetes than those without diabetes, highlighting the importance of focusing on NHPI adults as a priority population.

Our CVD prevalence were similar (25) or higher (5,26,58) than prior studies. We found that most groups Asian American and NHPI ethnic groups had lower odds of reporting CVD conditions than among white adults, which is conflicting with prior research (20,58,59). One explanation for this could be that our data were limited to larger types of CVD conditions. For instance, Japanese adults were found to have greater risk of subarachnoid hemorrhage than white adults, whereas Filipino adults had greater incidence of intracerebral hemorrhagic stroke (59). Our finding that Native Hawaiian adults were more likely to report stroke than white adults is also consistent with prior research (5). Some other reasons for these observed differences include our study focus on older adults, a national sample (versus California sample), adults enrolled in Medicare Advantage organizations (versus Kaiser Permanente Northern California system) and use of self-report data (versus International

Classification of Diseases codes from electronic health records) (4,5,25,58). Another explanation could be that Asian American and NHPI adults in our study were younger compared to white adults, which could explain the lower risk of CVD. In the Multi-Ethnic Study of Atherosclerosis (MESA), Chinese adults aged 45 to 74 years old had the lowest incidence of hypertension compared to white, African American and Hispanic groups, but Chinese adults aged 75 to 84 years old had the highest incidence of hypertension (60). Lower CVD risk may also be explained by unmeasured protective individual- or contextual-level enabling factors like family support or community cohesion, which may improve the resources available to access health care. It is also worth noting that Multiple race Asian adults in our sample generally reported high prevalence of CVD risk factors and CVD conditions compared to other Asian American groups, which may warrant further investigation into the health of multiracial populations.

Compared to white adults, we found that more Asian American and NHPI adults reported having less than a high school degree, income less than $10,000, and Medicare/Medicaid. This finding is consistent with previous studies that refute to the model minority stereotype (i.e., Asian Americans are wealthier and attained more education compared to racial/ethnic minority groups) (61). In relation to our theoretical model, we expect that an individual with lower social status (lower education attainment) would also have less access to enabling resources (income and insurance) to prevent or treat health issues (CVD risk factors). This pathway could partially explain the distinct patterning of CVD risk factors and CVD conditions by racial/ethnic groups. There is strong evidence that socioeconomic factors adversely

affect health outcomes, underscoring the need to better address the social determinants of health underlying the high prevalence of CVD risk factors in Asian American and NHPI groups (62). The variation of predisposing factors by ethnic group could also indicate the heterogeneity in immigration and acculturation experiences.

Our sub analyses on the moderating effects of language mainly spoken at home and English proficiency showed little evidence that language proficiency impacts CVD health, which is consistent with the mixed associations between acculturation measures and health outcomes (10). Collecting acculturation information like year of entry into the US, country of origin, or cultural values could improve our ability to understand health behaviors, the drivers of better or worse CVD in disaggregated Asian American and NHPI groups, particularly among high-risk groups. Understanding the mechanisms in which acculturation and racism might be functioning in CVD disparities would shift the focus towards addressing social determinants of health, like limited health care access and culturally insensitive clinical interactions.

When interpreting our results, this study has several limitations that should be noted. First, as a cross-sectional analysis, we are unable to determine the causal mechanisms that may explain the variation in associations among race/ethnicity and CVD. Second, the HOS are self-reported data and subject to recall bias. The HOS does not have detailed information about the type of CVD diagnoses, when CVD events happened or how long individuals have been diagnosed with CVD risk factors or CVD conditions. For example, some Asian American groups have greater

incidence of subarachnoid and intracerebral hemorrhagic stroke than whites, but the details of stroke were confined to yes or no (20). Third, our findings might be underestimating the prevalence of CVD risk factors and CVD, particularly among older immigrants and non-citizens, those with limited English proficiency, and those with different insurance types. The focus on older adults may be excluding individuals less than 65 years old who have CVD and biased towards individuals who survived into older age and were healthy enough to answer the survey. We were unable to control for other traditional or lifestyle risk factors, like diet and physical inactivity. For instance, low or insufficient levels of physical activity have been reported in Asian American and NHPI groups compared to whites (20,48). The HOS physical activity questions are framed around communication with a provider about physical exercise and not frequency or intensity of physical exercise. Fourth, we had to combine data for the other Pacific Islander groups due to small sample sizes. We acknowledge there is variation within these ethnic groups and that these data are not reflective of the heterogeneity of CVD for other Asian American (e.g., Bangladeshi) and NHPI (e.g., Chamorro) ethnic groups. However, we were able to describe CVD risk factors and CVD among a large and diverse sample of Asian American and NHPI community-dwelling older adults. Lastly, the HOS asks about language mainly spoken at home and how well respondents speak English, but these questions were not consistently asked for all survey years. The HOS also does not collect information on acculturation or experiences of racism. We included whether a proxy completed the survey to account for ability to complete the survey due to possible language limitations or health status. However, these variables may not fully account for

comprehension of survey questions and understanding of CVD conditions (63,64). Despite these limitations, our study provides crucial insights into the associations among disaggregated Asian American and NHPI groups and CVD.

The current study describes the burden of CVD risk factors and CVD prevalence among Asian American and NHPI older adults and identifies racial/ethnic groups at high-risk for CVD. More attention should be focused on NHPI groups as a priority population based on our finding that NHPI adults were more likely to report CVD risk factors and CVD conditions compared to their white and Asian American counterparts. CVD diagnosis is only one step in the care continuum and subsequent studies should examine the development of CVD risk factors and maintenance or treatment of CVD in Asian American and NHPI adults starting at younger age and over the life course. Future research should oversample and disaggregate racial/ethnic group information whenever possible to provide accurate depictions of health and ensure ability to tests research hypotheses. For recruitment and oversampling of hard-to-reach populations, the protocols utilized for the NHPI National Health Interview Survey are an example of how national surveys might employ strategies for sampling and increasing response rates (65). The solutions to eliminate disparities in Asian American and NHPI populations are complex. Identifying factors like how socioeconomic status and discriminatory experiences influence health and access to health care services may be important for future prevention efforts to improve health and reduce disparities in this population.

Table 2.1. Predisposing, enabling and need characteristics of CVD, by total sample and racial/ethnic group, Medicare Health Outcomes Survey, 2011-2015

Characteristic	Total Sample	White	All Asian [1]	Asian Indian	Chinese	Filipino	Japanese	Korean	Vietnamese	Other Asian	Multiple race Asian	All NHPI [2]	Native Hawaiian	Other Pacific Islander	*p-value* [3]
No.	639,862	608,083	23,435	2,858	6,251	5,610	3,582	1,714	2,026	1,394	3,418	4,926	2,237	2,689	
Predisposing characteristics															
Female, %	56.6	56.7	53.6	40.3	50.8	64.6	60.5	49.6	44.7	49.2	55.2	60.9	62.9	59.3	<.001
Mean age (SD), years	74.3 (7.0)	74.4 (7.0)	74.2 (7.0)	72.2 (5.8)	74.5 (7.1)	74.8 (6.7)	76.8 (8.1)	72.6 (5.9)	72.1 (5.6)	73.2 (6.4)	73.7 (6.7)	73.1 (6.3)	73.0 (5.9)	73.1 (6.6)	<.001
Age group, years															
65 - 69	30.6	30.6	31.1	40.0	30.9	25.5	24.5	35.5	40.1	34.8	33.1	36.2	34.6	37.5	
70 - 74	27.0	27.0	27.7	31.5	25.3	28.8	21.0	33.5	31.3	30.6	28.0	29.5	31.6	27.9	
75 - 79	19.2	19.2	19.2	16.8	19.5	22.2	17.2	18.6	17.8	18.5	18.8	18.1	18.7	17.7	
80 - 84	13.2	13.3	12.7	7.9	14.5	14.1	17.5	7.5	8.1	9.5	12.3	10.1	10.4	9.9	
More than 85	9.9	10.0	9.4	3.9	9.9	9.5	19.7	4.8	2.7	6.5	7.8	6.0	4.8	7.1	<.001
Education, %															
Less than high school	14.4	13.7	27.9	22.2	36.2	29.4	10.0	15.3	41.0	38.6	28.7	41.1	22.0	57.1	
High school graduate or GED	34.8	35.4	20.7	13.4	18.7	15.8	35.9	21.2	25.7	17.1	24.3	32.2	43.4	22.7	
Some college	26.5	27.0	16.9	11.8	14.0	16.1	26.9	15.7	20.4	14.6	20.8	17.7	24.1	12.2	
College degree or more	24.3	24.0	34.5	52.6	31.1	38.7	27.2	47.9	12.9	29.8	26.2	9.0	10.3	8.0	<.001
Married, %	58.6	58.6	64.4	76.5	69.0	57.7	51.2	73.6	71.0	59.6	54.9	41.2	40.4	41.8	<.001
Enabling resources															

Household income, %															
Less than $10,000	8.1	7.4	19.8	19.2	23.2	21.6	6.7	17.4	25.0	26.2	22.8	27.1	18.7	34.1	
$10,000 – 19,999	17.7	17.6	20.6	16.5	25.0	18.1	12.7	22.5	33.4	18.3	18.5	19.8	18.8	20.6	
$20,000-29,999	17.4	17.7	10.9	10.0	10.3	10.0	12.7	13.4	12.0	9.5	12.3	11.0	12.1	10.2	
$30,000-49,999	23.0	23.5	15.3	15.2	12.3	14.9	21.6	19.5	11.0	15.1	14.7	11.9	14.7	9.5	
$50,000 or more	23.5	23.9	19.0	26.2	16.7	14.6	32.1	20.6	6.9	15.1	14.4	10.9	17.5	5.5	
Don’t know	10.2	9.9	14.5	13.0	12.5	20.8	14.2	6.6	11.7	15.7	17.3	19.3	18.1	20.3	
Medicare/Medicaid, %	12.3	10.8	39.6	38.7	42.2	46.8	8.5	29.5	66.1	54.4	39.8	45.7	32.6	56.6	<.001
Contextual need factors															
CMS regional office, % [4]															
Atlanta	14.1	14.4	6.0	15.0	4.1	3.0	1.8	13.1	6.9	8.9	11.2	9.2	1.9	15.4	
Boston	6.4	6.6	3.0	4.5	4.2	0.8	0.9	2.6	7.1	3.6	3.4	4.2	0.5 †	7.3	
Chicago	20.8	21.6	7.2	14.1	4.2	5.6	2.3	6.2	10.5	21.7	7.6	3.6	1.5	5.3	
Dallas	9.4	9.6	5.4	13.1	3.6	3.0	1.5	3.0	14.6	7.5	8.0	4.2	2.0	6.0	
Denver	4.7	4.8	1.2	0.8 †	1.0	0.3 †	2.7	2.0	1.3	2.4	2.2	2.1	1.6	2.5	
Kansas City	6.0	6.2	1.7	1.6	1.1	1.8	2.3	1.3 †	2.2	1.4 †	2.3	1.9	3.0	1.1	
New York	7.9	7.7	9.9	26.1	11.9	6.8	1.3	12.0	1.3	13.1	11.5	17.2	1.7	30.0	
Philadelphia	8.7	8.9	4.3	8.5	2.8	2.1	1.5	12.3	6.9	4.6	4.2	2.9	0.8	4.7	
San Francisco	12.6	10.4	55.7	13.4	62.7	72.0	79.0	39.0	38.6	30.3	44.7	51.5	84.8	23.8	
Seattle	9.7	9.8	5.6	2.8	4.6	4.5	7.0	8.6	10.6	6.6	4.8	3.1	2.1	4.0	<.001
Person who completed survey, %															
Person addressed	91.6	92.5	73.3	79.3	69.2	75.9	85.0	69.2	62.0	59.0	81.1	75.1	90.0	62.2	
Family member	7.6	6.9	23.5	19.7	25.8	22.2	12.9	26.7	34.0	34.9	17.0	19.9	8.3	30.0	
Friend or caregiver	0.8	0.6	3.2	1.0	5.0	1.9	2.1	4.1	4.1	6.2	1.9	5.0	1.7	7.9	<.001

Abbreviations: *CMS* Centers for Medicare & Medicaid Services*; GED* General Equivalency Diploma; *NHPI* Native Hawaiian and Pacific Islander; *SD* standard deviation.

Note: Dashes "–" are displayed for cells with less than 11 respondents following the CMS cell size suppression policy. For cells with less than 25 respondents, we display † next to the percentage.

1 The all Asian category includes Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian.
2 The all NHPI category includes Native Hawaiian and other Pacific Islander.
3 We performed ANOVA and chi-square tests to compare disaggregated Asian American and NHPI ethnic groups to white adults (referent group).
4 The CMS regional offices are the state and local representation for Medicare Advantage plans and represent several states. The Atlanta region serves Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. The Boston region serves Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. The Chicago region serves Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. The Dallas region serves Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. The Denver region serves Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. The Kansas City region serves Iowa, Kansas, Missouri, and Nebraska. The New York region serves New Jersey, New York, Puerto Rico, and the Virgin Islands. The Philadelphia region serves Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia. The San Francisco region serves Arizona, California, Hawaii, Nevada, and Pacific Territories. The Seattle region serves Alaska, Idaho, Oregon, Washington.

Table 2. 2. Prevalence of CVD risk factors, by total sample, sex and racial/ethnic group, Medicare Health Outcomes Survey, 2011-2015

Individual Need Factors	Total Sample	White	All Asian [1]	Asian Indian	Chinese	Filipino	Japanese	Korean	Vietnamese	Other Asian	Multiple race Asian	All NHPI [2]	Native Hawaiian	Other PI	*p-value* [3]
Men, No.	278,082	263,744	10,878	1,706	3,077	1,987	1,416	864	1,120	708	1,534	1,926	831	1,095	
BMI mean (SD), kg/m2	27.9 (5.0)	28.1 (5.0)	24.6 (3.8)	25.1 (5.0)	23.9 (3.4)	25.3 (4.0)	25.4 (4.4)	24.2 (3.3)	23.4 (3.4)	25.5 (4.0)	26.2 (5.0)	28.5 (5.9)	29.1 (6.3)	28.1 (5.6)	<.001
BMI group, % [1]															
Normal	25.0	24.7	29.7	25.5	35.5	22.6	25.3	31.8	40.2	25.1	39.6	25.1	22.9	26.8	
Underweight	1.0	0.9	3.3	2.5	4.3	2.8	2.2	3.5	5.1	1.9	2.9	1.5	1.6	1.5	
Overweight	46.2	46.1	49.7	51.1	48.0	52.8	49.2	52.8	46.0	47.5	41.9	40.4	37.7	42.5	
Obese	27.8	28.3	17.3	20.9	12.2	21.9	23.2	11.9	8.7	25.5	15.6	33.0	37.8	29.3	<.001
Diabetes, %	26.0	25.5	34.1	44.2	28.2	40.1	29.9	28.2	31.3	39.3	37.4	41.5	37.0	44.7	<.001
Hypertension, %	63.6	63.5	64.4	62.3	61.8	72.6	63.9	52.1	70.3	63.8	66.0	71.2	70.7	71.6	<.001
Smoking, %															
Not at all	89.4	89.4	91.1	93.8	90.8	91.0	91.0	90.6	88.9	90.9	88.1	85.6	87.5	84.2	
Every day	7.0	7.1	5.1	3.4	5.8	5.3	6.1	4.4	4.8	5.1	5.8	7.1	7.2	7.1	
Some days	3.1	3.1	2.6	1.9	2.3	2.9	2.6	3.3	3.9	2.4 †	4.9	5.1	4.1	5.9	
Don’t know	0.4	0.4	1.1	0.9 †	1.1	0.9 †	–	1.7 †	2.4	–	1.1 †	2.1	–	2.8	<.001
Women, No.	371,408	353,332	12,913	1,194	3,248	3,747	2,219	870	928	707	1,990	3,173	1,316	1,857	
BMI mean (SD), kg/m2	27.6 (6.2)	27.7 (6.2)	24.0 (4.4)	26.0 (4.8)	23.3 (3.9)	24.7 (4.4)	23.4 (4.4)	23.4 (3.8)	23.1 (3.8)	25.2 (5.0)	26.4 (5.7)	28.9 (6.8)	29.0 (7.1)	28.9 (6.5)	<.001
BMI group, % [4]															
Normal	35.0	34.9	37.6	23.8	44.0	31.7	42.1	42.6	45.3	32.7	43.2	27.6	28.3	26.9	
Underweight	2.6	2.4	6.3	3.1	7.8	4.5	9.7	6.4	7.8	2.3	3.0	1.8	2.1	1.5	

Overweight	33.4	33.2	39.0	40.7	36.4	44.2	33.3	39.7	35.9	41.0	32.3	33.5	33.1	33.9	
Obese	29.1	29.5	17.1	32.4	11.8	19.6	14.9	11.3	10.9	24.0	21.6	37.1	36.5	37.7	<.001
Diabetes, %	20.9	20.4	29.8	37.7	26.2	34.4	24.1	23.1	29.6	35.3	35.6	38.8	35.9	41.3	<.001
Hypertension, %	64.3	64.1	67.1	65.9	63.4	78.1	60.9	54.4	67.2	63.9	70.6	75.1	74.8	75.3	<.001
Smoking Status, %															
No at all	91.1	90.9	96.2	98.0	97.9	95.5	94.1	95.0	96.3	96.6	92.0	88.3	84.8	91.4	
Every day	5.9	6.1	1.7	–	0.6 †	1.9	4.0	2.6 †	–	–	4.1	6.4	9.5	3.6	
Some days	2.6	2.6	1.0	–	0.4 †	1.6	1.3	–	–	–	2.6	3.8	5.1	2.5	
Don’t know	0.4	0.3	1.1	1.3 †	1.0	1.0	–	–	2.5 †	1.8 †	1.3 †	1.5	–	2.5	<.001

Abbreviations: *BMI* body mass index; *CVD* cardiovascular disease; *kg/m2* kilograms per meter square; *NHPI* Native Hawaiian and Pacific Islander; *SD* standard deviation

Note: Dashes “–” are displayed for cells with less than 11 respondents following the CMS cell size suppression policy. For cells with less than 25 respondents, we display † next to the percentage.

1 The all Asian category includes Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian.
2 The all NHPI category includes Native Hawaiian and other Pacific Islander.
3 We performed ANOVA and chi-square tests to compare disaggregated Asian American and NHPI ethnic groups to white adults (referent group).
4 Asian-specific BMI thresholds (normal = 18.5 – <23 kg/m2, overweight = 23 – 27.5 kg/m2, obese ≥ 27.5 kg/m2) were applied to Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, and Other Asian.

Table 2. 3. Prevalence of CVD conditions and stroke, by total sample, sex and racial/ethnic group, Medicare Health Outcomes Survey, 2011-2015

CVD condition or stroke	Total Sample	White	All Asian [1]	Asian Indian	Chinese	Filipino	Japanese	Korean	Vietnamese	Other Asian	Multiple race Asian	All NHPI [2]	Native Hawaiian	Other PI	*p-value* [3]
Men, No	278,082	269,686	11,175	1,750	3,143	2,057	1,452	894	1,150	729	1,612	2,033	763	1,270	
Coronary Artery Disease, %	18.4	18.7	12.1	19.3	10.9	11.6	11.0	8.6	8.5	12.8	16.3	16.4	17.2	15.7	<.001
Congestive Heart Failure, %	8.4	8.5	5.3	6.2	4.3	6.4	4.8	3.9	5.8	6.9	10.6	13.6	14.1	13.1	<.001
Myocardial Infarction, %	13.5	13.8	7.2	11.7	5.0	7.6	8.3	4.4	5.7	9.0	10.8	13.8	15.3	12.7	<.001
Other Heart Conditions, %	23.3	23.7	14.8	15.5	15.1	15.3	15.9	10.3	13.7	15.0	18.9	22.6	24.8	20.9	<.001
Stroke, %	7.7	7.7	7.1	7.6	6.0	9.7	6.7	4.2	7.5	7.5	10.0	12.5	12.4	12.7	<.001
Women, No	371,408	353,332	12,913	1,194	3,248	3,747	2,219	870	928	707	1,990	3,173	1,316	1,857	
Coronary Artery Disease, %	9.5	9.7	6.6	8.6	7.4	7.2	4.3	3.7	7.2	6.8	9.9	11.4	10.2	12.4	<.001
Congestive Heart Failure, %	6.2	6.4	4.0	4.7	2.7	4.9	2.8	3.0	6.1	6.0	7.2	9.7	9.2	10.2	<.001
Myocardial Infarction, %	6.2	6.3	3.4	5.1	3.2	3.4	3.4	2.1	3.6	3.7	6.0	7.5	8.5	6.6	<.001
Other Heart Conditions, %	20.1	20.3	14.3	12.6	15.3	15.5	14.3	9.5	13.5	13.7	18.3	18.9	18.9	19.0	<.001
Stroke, %	6.9	6.9	5.7	5.2	4.8	5.5	6.8	5.2	7.8	5.6	8.6	9.4	11.9	7.2	<.001

Abbreviations: *CVD* cardiovascular disease; *NHPI* Native Hawaiian and Pacific Islander

[1] The all Asian category includes Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian.
[2] The all NHPI category includes Native Hawaiian and other Pacific Islander.
[3] We performed chi-square tests to compare disaggregated Asian American and NHPI groups.

Table 2. 4. Odds ratios and 95% confidence intervals of self-reported CVD type and stroke, by sex and racial/ethnic group, Medicare Health Outcomes Survey, 2011-2015

CVD type	Unadjusted Model	Model 1	Model 2
Men			
Coronary Artery Disease			
Asian Indian	1.04 (0.92, 1.18)	1.09 (0.97, 1.23)	0.96 (0.84, 1.10)
Chinese	0.54 (0.48, 0.60)	0.53 (0.47, 0.59)	0.48 (0.42, 0.55)
Filipino	0.57 (0.50, 0.66)	0.56 (0.49, 0.64)	0.46 (0.40, 0.54)
Japanese	0.54 (0.46, 0.64)	0.51 (0.43, 0.61)	0.55 (0.46, 0.66)
Korean	0.41 (0.32, 0.52)	0.42 (0.33, 0.54)	0.45 (0.35, 0.59)
Vietnamese	0.40 (0.33, 0.50)	0.42 (0.34, 0.53)	0.34 (0.27, 0.43)
Other Asian	0.64 (0.51, 0.80)	0.66 (0.53, 0.82)	0.55 (0.43, 0.70)
Multiple race Asian	0.85 (0.74, 0.97)	0.86 (0.75, 0.99)	0.77 (0.66, 0.90)
Native Hawaiian	0.90 (0.75, 1.09)	0.95 (0.79, 1.14)	0.91 (0.74, 1.11)
Other Pacific Islander	0.81 (0.69, 0.06)	0.85 (0.72, 1.00)	0.64 (0.53, 0.78)
White	Reference	Reference	Reference
Congestive Heart Failure			
Asian Indian	0.71 (0.58, 0.87)	0.77 (0.63, 0.94)	0.62 (0.50, 0.78)
Chinese	0.48 (0.40, 0.57)	0.47(0.39, 0.56)	0.34 (0.28, 0.41)
Filipino	0.73 (0.61, 0.88)	0.71 (0.59, 0.85)	0.43 (0.35, 0.53)
Japanese	0.53 (0.42, 0.69)	0.49 (0.38, 0.63)	0.48 (0.36, 0.62)
Korean	0.43 (0.31, 0.61)	0.46 (0.32, 0.65)	0.43 (0.30, 0.64)
Vietnamese	0.66 (0.52, 0.86)	0.73 (0.57, 0.94)	0.45 (0.34, 0.60)
Other Asian	0.79 (0.59, 1.06)	0.84 (0.62, 1.13)	0.44 (0.31, 0.62)
Multiple race Asian	1.27 (1.08, 1.50)	1.31 (1.11, 1.55)	0.92 (0.76, 1.11)
Native Hawaiian	1.77 (1.45, 2.15)	1.93 (1.59, 2.36)	1.30 (1.04, 1.63)
Other Pacific Islander	1.62 (1.36, 1.94)	1.75 (1.47, 2.10)	0.80 (0.65, 0.99)
White	Reference	Reference	Reference
Myocardial infarction			
Asian Indian	0.82 (0.71, 0.96)	0.86 (0.74, 1.00)	0.80 (0.68, 0.94)
Chinese	0.33 (0.28, 0.39)	0.32 (0.28, 0.38)	0.28 (0.23, 0.33)
Filipino	0.51 (0.44, 0.61)	0.50 (0.43, 0.60)	0.36 (0.30, 0.44)
Japanese	0.57 (0.47, 0.68)	0.54 (0.45, 0.65)	0.58 (0.48, 0.71)
Korean	0.29 (0.21, 0.40)	0.30 (0.22, 0.41)	0.28 (0.20, 0.41)
Vietnamese	0.38 (0.29, 0.49)	0.40 (0.31, 0.51)	0.30 (0.23, 0.39)
Other Asian	0.62 (0.48, 0.80)	0.64 (0.49, 0.83)	0.48 (0.35, 0.64)
Multiple race Asian	0.76 (0.64, 0.89)	0.77 (0.65, 0.91)	0.67 (0.56, 0.80)
Native Hawaiian	1.13 (0.93, 1.37)	1.18 (0.98, 1.43)	1.00 (0.81, 1.24)
Other Pacific Islander	0.91 (0.76, 1.09)	0.95 (0.79, 1.13)	0.60 (0.49, 0.74)
White	Reference	Reference	Reference
Other heart conditions			
Asian Indian	0.59 (0.54, 0.67)	0.64 (0.56, 0.73)	0.55 (0.48, 0.64)
Chinese	0.58 (0.60, 0.69)	0.56 (0.51, 0.62)	0.49 (0.43, 0.54)
Filipino	0.58 (0.61, 0.71)	0.56 (0.50, 0.63)	0.46 (0.40, 0.52)
Japanese	0.61 (0.58, 0.69)	0.56 (0.48, 0.65)	0.58 (0.50, 0.68)
Korean	0.37 (0.34, 0.46)	0.39 (0.31, 0.48)	0.37 (0.29, 0.47)
Vietnamese	0.51 (0.50, 0.64)	0.56 (0.47, 0.66)	0.46 (0.38, 0.55)

Other Asian	0.57 (0.52, 0.70)	0.60 (0.48, 0.73)	0.49 (0.39, 0.62)
Multiple race Asian	0.75 (0.75, 0.90)	0.77 (0.67, 0.87)	0.72 (0.63, 0.83)
Native Hawaiian	1.06 (0.87, 1.06)	1.15 (0.98, 1.35)	1.03 (0.86, 1.23)
Other Pacific Islander	0.86 (0.81, 0.98)	0.91 (0.79, 1.06)	0.69 (0.58, 0.82)
White	Reference	Reference	Reference
Stroke			
Asian Indian	0.98 (0.82, 1.18)	1.07 (0.89, 1.28)	0.78 (0.63, 0.95)
Chinese	0.77 (0.67, 0.90)	0.76 (0.65, 0.88)	0.48 (0.42, 0.59)
Filipino	1.29 (1.11, 1.49)	1.25 (1.08, 1.45)	0.75 (0.63, 0.89)
Japanese	0.86 (0.69, 1.06)	0.79 (0.64, 1.97)	0.76 (0.61, 0.96)
Korean	0.52 (0.38, 0.73)	0.56 (0.40, 0.78)	0.47 (0.33, 0.66)
Vietnamese	0.97 (0.78, 1.22)	1.07 (0.85, 1.34)	0.54 (0.42, 0.70)
Other Asian	0.98 (0.74, 1.30)	1.03 (0.78, 1.37)	0.62 (0.45, 0.84)
Multiple race Asian	1.33 (1.12, 1.57)	1.37 (1.15, 1.62)	0.92 (0.76, 1.12)
Native Hawaiian	1.70 (1.38, 2.09)	1.85 (1.50, 2.27)	1.44 (1.14, 1.82)
Other Pacific Islander	1.74 (1.45, 2.08)	1.87 (1.56, 2.24)	0.81 (0.65, 1.01)
White	Reference	Reference	Reference
Women			
Coronary Artery Disease			
Asian Indian	0.89 (0.72, 1.09)	0.99 (0.81, 1.23)	0.70 (0.56, 0.88)
Chinese	0.75 (0.65, 0.86)	0.75 (0.65, 0.59)	0.56 (0.48, 0.66)
Filipino	0.73 (0.64, 0.83)	0.72 (0.64, 0.64)	0.51 (0.44, 0.59)
Japanese	0.42 (0.34, 0.52)	0.37 (0.30, 0.61)	0.40 (0.32, 0.51)
Korean	0.36 (0.25, 0.51)	0.39 (0.27, 0.54)	0.30 (0.20, 0.45)
Vietnamese	0.73 (0.56, 0.94)	0.81 (0.63, 0.53)	0.49 (0.37, 0.65)
Other Asian	0.69 (0.51, 0.93)	0.71 (0.53, 0.82)	0.48 (0.34, 0.68)
Multiple race Asian	1.04 (0.89, 1.21)	1.07 (0.92, 0.99)	0.80 (0.67, 0.96)
Native Hawaiian	1.06 (0.89, 1.27)	1.13 (0.95, 1.14)	0.87 (0.71, 1.05)
Other Pacific Islander	1.33 (1.15, 1.55)	1.40 (1.20, 1.00)	0.80 (0.67, 0.95)
White	Reference	Reference	Reference
Congestive Heart Failure			
Asian Indian	0.73 (0.55, 0.96)	0.87 (0.66, 1.15)	0.42 (0.31, 0.58)
Chinese	0.41 (0.33, 0.51)	0.41 (0.33, 0.51)	0.20 (0.16, 0.26)
Filipino	0.76 (0.65, 0.89)	0.76 (0.65, 0.88)	0.39 (0.33, 0.46)
Japanese	0.43 (0.33, 0.55)	0.35 (0.27, 0.45)	0.31 (0.23, 0.41)
Korean	0.45 (0.30, 0.67)	0.52 (0.35, 0.78)	0.30 (0.19, 0.48)
Vietnamese	0.97 (0.74, 1.28)	1.17 (0.89, 1.55)	0.48 (0.35, 0.65)
Other Asian	0.93 (0.68, 1.29)	1.00 (0.72, 1.37)	0.42 (0.29, 0.61)
Multiple race Asian	1.16 (0.97, 1.38)	1.22 (1.03, 1.46)	0.76 (0.62, 0.93)
Native Hawaiian	1.50 (1.25, 1.80)	1.68 (1.57, 2.02)	0.98 (0.80, 1.21)
Other Pacific Islander	1.70 (1.44, 2.00)	1.85 (1.06, 2.18)	0.78 (0.64, 0.95)
White	Reference	Reference	Reference
Myocardial infarction			
Asian Indian	0.79 (0.61, 1.03)	0.89 (0.68, 1.16)	0.59 (0.44, 0.80)
Chinese	0.49 (0.40, 0.60)	0.49 (0.40, 0.59)	0.33 (0.26, 0.41)
Filipino	0.52 (0.44, 0.62)	0.52 (0.43, 0.62)	0.34 (0.28, 0.41)
Japanese	0.52 (0.41, 0.66)	0.46 (0.36, 0.58)	0.48 (0.37, 0.62)

Korean	0.32 (0.20, 0.51)	0.35 (0.22, 0.56)	0.26 (0.16, 0.44)
Vietnamese	0.55 (0.39, 0.79)	0.62 (0.43, 0.88)	0.30 (0.20, 0.45)
Other Asian	0.57 (0.38, 0.85)	0.59 (0.40, 0.88)	0.34 (0.22, 0.54)
Multiple race Asian	0.94 (0.78, 1.14)	0.97 (0.80, 1.18)	0.67 (0.54, 0.83)
Native Hawaiian	1.37 (1.13, 1.66)	1.46 (1.20, 1.76)	1.06 (0.86, 1.30)
Other Pacific Islander	1.04 (0.85, 1.27)	1.09 (0.89, 1.34)	0.60 (0.48, 0.75)
White	Reference	Reference	Reference
Other heart conditions			
Asian Indian	0.57 (0.48, 0.68)	0.62 (0.52, 0.74)	0.50 (0.41, 0.61)
Chinese	0.71 (0.64, 0.78)	0.71 (0.64, 0.78)	0.60 (0.54, 0.67)
Filipino	0.72 (0.66, 0.79)	0.71 (0.65, 0.78)	0.56 (0.51, 0.62)
Japanese	0.66 (0.58, 0.74)	0.58 (0.52, 0.66)	0.59 (0.51, 0.67)
Korean	0.41 (0.33, 0.52)	0.44 (0.35, 0.56)	0.41 (0.32, 0.53)
Vietnamese	0.61 (0.50, 0.74)	0.67 (0.56, 0.82)	0.51 (0.41, 0.63)
Other Asian	0.62 (0.50, 0.77)	0.64 (0.51, 0.80)	0.52 (0.40, 0.67)
Multiple race Asian	0.88 (0.78, 0.99)	0.91 (0.80, 1.02)	0.82 (0.72, 0.94)
Native Hawaiian	0.91 (0.80, 1.05)	0.96 (0.84, 1.10)	0.82 (0.71, 0.96)
Other Pacific Islander	0.92 (0.81, 1.05)	0.96 (0.85, 1.09)	0.76 (0.66, 0.88)
White	Reference	Reference	Reference
Stroke			
Asian Indian	0.73 (0.56, 0.95)	0.84 (0.65, 1.09)	0.43 (0.32, 0.57)
Chinese	0.68 (0.58, 0.80)	0.68 (0.57, 0.80)	0.33 (0.28, 0.40)
Filipino	0.79 (0.68, 0.91)	0.78 (0.68, 0.90)	0.39 (0.33, 0.46)
Japanese	0.98 (0.83, 1.16)	0.84 (0.71, 1.00)	0.75 (0.63, 0.91)
Korean	0.74 (0.54, 1.00)	0.83 (0.61, 1.12)	0.43 (0.31, 0.61)
Vietnamese	1.14 (0.89, 1.46)	1.31 (1.03, 1.68)	0.47 (0.36, 0.62)
Other Asian	0.79 (0.57, 1.10)	0.83 (0.60, 1.16)	0.38 (0.26, 0.55)
Multiple race Asian	1.26 (1.07, 1.48)	1.31 (1.11, 1.54)	0.75 (0.62, 0.91)
Native Hawaiian	1.82 (1.55, 2.14)	1.98 (1.68, 2.33)	1.31 (1.09, 1.58)
Other Pacific Islander	1.05 (0.86, 1.27)	1.11 (0.91, 1.34)	0.54 (0.43, 0.67)
White	Reference	Reference	Reference

Note: Bold values denote statistical significance at the $p < 0.05$ level.

1 Model 1: adjusted for age and sex.
2 Model 2: adjusted for predisposing factors (age, sex, marital status, education level), enabling factors (income and Medicaid eligibility), individual need factors (BMI, hypertension, diabetes, smoking status), and contextual need factors (plan's CMS regional office, person who completed the survey, survey year).

Table 2. 5. Supplemental - Prevalence of CVD risk factors, by total sample and racial/ethnic group, Medicare Health Outcomes Survey, 2011-2015

CVD Risk Factor	Total Sample	White	All Asian [1]	Asian Indian	Chinese	Filipino	Japanese	Korean	Vietnamese	Other Asian	Multiple race Asian	All NHPI [2]	Native Hawaiian	Other PI	*p-value* [3]
No.	639,862	608,083	23,435	2,858	6,251	5,610	3,582	1,714	2,026	1,394	3,418	4,926	1,997	2,929	
Modifiable Risk Factors															
BMI mean (SD), kg/m2	27.7 (5.7)	27.9 (5.7)	24.3 (4.1)	25.4 (4.3)	23.6 (3.7)	24.9 (4.3)	24.2 (4.5)	23.8 (3.6)	23.3 (3.6)	25.3 (4.5)	26.3 (5.4)	28.8 (6.4)	29.0 (6.8)	28.6 (6.1)	<.001
BMI group, % [4]															
Normal	30.6	30.5	34.0	24.8	39.8	28.5	35.5	37.1	42.5	28.8	41.8	26.6	26.3	26.8	
Underweight	1.9	1.8	4.9	2.7	6.1	3.9	6.7	5.0	6.4	2.1	2.9	1.7	1.9	1.5	
Overweight	39.0	38.8	43.9	47.0	42.1	47.2	39.6	46.3	41.5	44.3	36.6	36.1	34.8	37.4	
Obese	28.5	29.0	17.2	25.5	12.0	20.4	18.2	11.6	9.7	24.8	18.7	35.5	37.0	34.3	<.001
Diabetes, %	23.2	22.6	31.8	41.7	27.1	36.5	26.3	25.6	30.7	37.2	36.4	39.8	35.9	43.1	<.001
Hypertension, %	64.0	63.8	65.8	63.7	62.6	76.2	62.1	53.2	68.9	63.8	68.6	73.6	73.3	73.8	<.001
Smoking, %															
No at all	90.4	90.3	93.8	94.5	94.4	93.9	92.9	92.8	92.2	93.7	90.3	87.3	85.8	88.5	
Every day	6.4	6.5	3.3	2.1	3.2	3.1	4.8	3.5	2.9	3.0	4.9	6.7	8.6	5.0	
Some days	2.8	2.8	1.8	1.3	1.4	2.1	1.9	2.2	2.4	1.7 †	3.7	4.3	4.8	3.9	
Don't know	0.4	0.4	1.1	1.1	1.1	0.9	0.4	1.5	2.5	1.7 †	1.2	1.8	0.8 †	2.6	<.001

Abbreviations: *BMI* body mass index; *CVD* cardiovascular disease; *kg/m2* kilograms per meter square; *NHPI* Native Hawaiian and Pacific Islander; *SD* standard deviation

Note: Dashes "–" are displayed for cells with less than 11 respondents following the CMS cell size suppression policy. For cells with less than 25 respondents, we display † next to the percentage.

1 The all Asian category includes Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian.
2 The all NHPI category includes Native Hawaiian and other Pacific Islander.
3 We performed ANOVA and chi-square tests to compare disaggregated Asian American and NHPI ethnic groups to white adults (referent group).
4 Asian-specific BMI thresholds (normal = 18.5 – <23 kg/m2, overweight = 23 – 27.5 kg/m2, obese ≥ 27.5 kg/m2) were applied to Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, and Other Asian.

Table 2. 6. Supplemental - Prevalence of CVD conditions and stroke, by total sample and racial/ethnic group, Medicare Health Outcomes Survey, 2011-2015

CVD condition or stroke	Total Sample	White	All Asian [1]	Asian Indian	Chinese	Filipino	Japanese	Korean	Vietnamese	Other Asian	Multiple race Asian	All NHPI [2]	Native Hawaiian	Other PI	*p-value* [3]
No.	639,862	608,083	608,083	2,858	6,251	5,610	3,582	1,714	2,026	1,394	3,418	4,926	1,997	2,929	
Coronary Artery Disease, %	13.4	13.5	9.2	15.0	9.1	8.7	7.0	6.2	7.9	9.9	12.8	13.3	12.8	13.8	<.001
Congestive Heart Failure, %	7.2	7.3	4.6	5.6	3.5	5.4	3.6	3.4	6.0	6.4	8.7	11.2	11.0	11.4	<.001
Myocardial Infarction, %	9.4	9.6	5.2	9.0	4.1	4.9	5.3	3.3	4.8	6.4	8.1	9.9	11.0	9.1	<.001
Other Heart Conditions, %	21.5	21.8	14.5	14.3	15.2	15.4	14.9	9.9	13.6	14.3	18.6	20.4	21.1	19.8	<.001
Stroke, %	7.3	7.3	6.4	6.6	5.4	7.0	6.7	4.7	7.6	6.6	9.2	10.6	12.1	9.4	<.001

Abbreviations: *CVD* cardiovascular disease; *NHPI* Native Hawaiian and Pacific Islander

[1] The all Asian category includes Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian.
[2] The all NHPI category includes Native Hawaiian and other Pacific Islander.
[3] We performed chi-square tests to compare disaggregated Asian American and NHPI ethnic groups to white adults (referent group).

Table 2. 7. Supplemental - Odds ratios and 95% confidence intervals of self-reported CVD type and stroke by racial/ethnic group, Medicare Health Outcomes Survey, 2011-2015

CVD type	Unadjusted Model	Model 1 [1]	Model 2 [2]
Coronary Artery Disease			
Asian Indian	1.13 (1.01, 1.25)	1.07 (0.96, 1.19)	0.86 (0.77, 0.97)
Chinese	0.64 (0.59, 0.70)	0.60 (0.55, 0.66)	0.50 (0.45, 0.55)
Filipino	0.61 (0.56, 0.67)	0.64 (0.58, 0.70)	0.49 (0.44, 0.54)
Japanese	0.48 (0.42, 0.54)	0.45 (0.40, 0.51)	0.48 (0.42, 0.56)
Korean	0.42 (0.34, 0.51)	0.41 (0.34, 0.50)	0.40 (0.32, 0.50)
Vietnamese	0.55 (0.46, 0.65)	0.53 (0.45, 0.63)	0.37 (0.31, 0.45)
Other Asian	0.70 (0.58, 0.83)	0.68 (0.57, 0.81)	0.51 (0.42, 0.62)
Multiple race Asian	0.94 (0.85, 1.04)	0.94 (0.85, 1.05)	0.76 (0.68, 0.86)
Native Hawaiian	0.94 (0.83, 1.06)	1.03 (0.91, 1.17)	0.88 (0.77, 1.01)
Other Pacific Islander	1.02 (0.91, 1.14)	1.09 (0.97, 1.22)	0.72 (0.63, 0.81)
White	Ref	Ref	Ref
Congestive Heart Failure			
Asian Indian	0.75 (0.64, 0.89)	0.81 (0.69, 0.95)	0.54 (0.45, 0.65)
Chinese	0.46 (0.40, 0.53)	0.44 (0.38, 0.51)	0.27 (0.23, 0.32)
Filipino	0.73 (0.65, 0.82)	0.73 (0.65, 0.83)	0.41 (0.36, 0.47)
Japanese	0.47 (0.40, 0.57)	0.41 (0.34, 0.49)	0.39 (0.32, 0.47)
Korean	0.45 (0.35, 0.59)	0.49 (0.37, 0.63)	0.38 (0.28, 0.51)
Vietnamese	0.81 (0.67, 0.97)	0.89 (0.74, 1.07)	0.46 (0.37, 0.56)
Other Asian	0.87 (0.70, 1.08)	0.91 (0.73, 1.13)	0.44 (0.35, 0.57)
Multiple race Asian	1.22 (1.09, 1.38)	1.27 (1.13, 1.43)	0.82 (0.72, 0.95)
Native Hawaiian	1.58 (1.38, 1.81)	1.79 (1.56, 2.05)	1.13 (0.97, 1.31)
Other Pacific Islander	1.65 (1.46, 1.86)	1.81 (1.60, 2.04)	0.79 (0.69, 0.91)
White	Ref	Ref	Ref
Myocardial infarction			
Asian Indian	0.93 (0.82, 1.06)	0.87 (0.77, 1.00)	0.73 (0.63, 0.83)
Chinese	0.40 (0.36, 0.46)	0.37 (0.33, 0.43)	0.29 (0.25, 0.33)
Filipino	0.49 (0.43, 0.55)	0.51 (0.45, 0.58)	0.35 (0.31, 0.40)
Japanese	0.53 (0.46, 0.62)	0.51 (0.44, 0.59)	0.54 (0.46, 0.63)
Korean	0.32 (0.25, 0.42)	0.31 (0.24, 0.41)	0.29 (0.22, 0.39)
Vietnamese	0.47 (0.38, 0.58)	0.45 (0.37, 0.56)	0.28 (0.22, 0.36)
Other Asian	0.65 (0.52, 0.80)	0.62 (0.50, 0.78)	0.42 (0.33, 0.53)
Multiple race Asian	0.84 (0.74, 0.95)	0.84 (0.74, 0.95)	0.64 (0.56, 0.74)
Native Hawaiian	1.17 (1.02, 1.34)	1.31 (1.14, 1.50)	1.03 (0.89, 1.20)
Other Pacific Islander	0.94 (0.82, 1.08)	1.01 (0.88, 1.15)	0.60 (0.52, 0.70)
White	Ref	Ref	Ref
Other heart conditions			
Asian Indian	0.60 (0.54, 0.67)	0.63 (0.57, 0.70)	0.54 (0.48, 0.60)
Chinese	0.65 (0.60, 0.69)	0.63 (0.59, 0.68)	0.54 (0.50, 0.58)
Filipino	0.66 (0.61, 0.71)	0.65 (0.61, 0.70)	0.53 (0.48, 0.57)

Japanese	0.63 (0.58, 0.69)	0.57 (0.52, 0.63)	0.58 (0.53, 0.64)
Korean	0.39 (0.34, 0.46)	0.41 (0.35, 0.48)	0.39 (0.33, 0.46)
Vietnamese	0.57 (0.50, 0.64)	0.60 (0.53, 0.69)	0.47 (0.41, 0.54)
Other Asian	0.60 (0.52, 0.70)	0.62 (0.53, 0.72)	0.51 (0.44, 0.61)
Multiple race Asian	0.82 (0.75, 0.90)	0.84 (0.77, 0.92)	0.76 (0.69, 0.84)
Native Hawaiian	0.96 (0.87, 1.06)	1.03 (0.93, 1.15)	0.92 (0.82, 1.03)
Other Pacific Islander	0.89 (0.81, 0.98)	0.94 (0.85, 1.03)	0.73 (0.66, 0.82)
White	Ref	Ref	Ref
Stroke			
Asian Indian	0.90 (0.78, 1.05)	0.98 (0.85, 1.14)	0.62 (0.53, 0.74)
Chinese	0.73 (0.66, 0.82)	0.72 (0.64, 0.80)	0.41 (0.36, 0.46)
Filipino	0.96 (0.87, 1.07)	0.96 (0.86, 1.06)	0.51 (0.45, 0.57)
Japanese	0.92 (0.81, 1.05)	0.82 (0.72, 0.94)	0.75 (0.65, 0.87)
Korean	0.63 (0.50, 0.79)	0.68 (0.54, 0.85)	0.47 (0.37, 0.60)
Vietnamese	1.06 (0.90, 1.25)	1.17 (0.99, 1.38)	0.51 (0.42, 0.62)
Other Asian	0.90 (0.73, 1.11)	0.94 (0.76, 1.16)	0.48 (0.38, 0.61)
Multiple race Asian	1.29 (1.15, 1.45)	1.34 (1.19, 1.50)	0.81 (0.71, 0.93)
Native Hawaiian	1.76 (1.55, 2.00)	1.93 (1.69, 2.19)	1.37 (1.19, 1.58)
Other Pacific Islander	1.33 (1.17, 1.52)	1.43 (1.25, 1.63)	0.65 (0.56, 0.76)
White	Ref	Ref	Ref

Note: Bold values denote statistical significance at the $p < 0.05$ level.

[1] Model 1: adjusted for age and sex.
[2] Model 2: adjusted for predisposing factors (age, sex, marital status, education level), enabling factors (income and Medicaid eligibility), individual need factors (BMI, hypertension, diabetes, smoking status), and contextual need factors (plan's CMS regional office, person who completed the survey, survey year).

CHAPTER 3. SECOND MANUSCRIPT

Associations between Cardiovascular Disease and Health-Related Quality of Life Among Asian American and Native Hawaiian and Pacific Islander Ethnic Groups

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ABSTRACT

Background and Objectives: Cardiovascular disease (CVD) is the leading cause of death for Asian American and Native Hawaiian and Pacific Islander (NHPI) older adults. Understanding health-related quality of life (HRQOL) may help explain discrepant CVD rates across this diverse population. The purpose of this study was to assess the relationship between CVD and HRQOL among 10 disaggregated Asian American and NHPI ethnic groups compared to white adults.

Research Design and Methods: Data were from the 2011-2015 baseline cohorts of the Medicare Health Outcomes Survey, a panel survey of adults aged 65 and older enrolled in Medicare Advantage health plans (N = 618,154). HRQOL was operationalized by the Veterans RAND 12-Item Survey that is composed of physical component scores (PCS) and mental component scores (MCS). Lower scores represent worse health. Respondents who self-reported having coronary artery disease, congestive heart failure, myocardial infarction, other heart conditions, or stroke were categorized as having CVD. We conducted multivariate regression to estimate the PCS and MCS mean score differences in relation to CVD status by racial/ethnic group.

Results: Overall, adults who self-reported a CVD condition had lower PCS and MCS scores than adults without CVD. There were marked differences in PCS and MCS scores across disaggregated Asian American and NHPI ethnic groups. After adjusting for covariates, compared to white adults, Asian American and NHPI ethnic groups had better PCS but worse MCS, though differences were not statistically significant

for all ethnic groups. Furthermore, race/ethnicity moderated the relationship between CVD and HRQOL.

Discussion and Implications: Compared to white adults, we found that Asian American and NHPI adults with CVD experience worse mental health, but better physical health status, which may be explained by CVD risk factors.

Introduction

Cardiovascular disease (CVD) is the leading cause of mortality in the United States, accounting for over 25% of deaths in individuals 65 and older in 2017 (42,66), and is a major cause of morbidity (67), disability (68), and healthcare expenditures (69). Research has demonstrated that significant racial/ethnic disparities exist in CVD mortality and CVD risk factors (66,70), and these health disparities persist in the maintenance of chronic diseases in older age (71). Therefore, understanding outcomes beyond mortality, like health-related quality of life (HRQOL), can help assess individual well-being and monitor clinical changes contributing to CVD (72). The American Heart Association (AHA) released the 2030 Impact Goals, highlighting their priorities to increase healthy life expectancy (e.g., HRQOL), center work around equity, and improve health and well-being (73).

HRQOL can measure the effects of chronic diseases like diabetes or stroke on daily physical and mental health burdens (74). HRQOL is not uniformly operationalized in the literature and includes outcomes like general health perceptions, physical functioning, psychological health (e.g., happiness and life satisfaction), social relationships and cognitive functioning (72,75). As an example, HRQOL can be defined as general health perceptions or a combination of physical functioning and mental health. General health perceptions have been shown to be a strong predictor of mortality, declines in health, and hospitalization (72,76). Prior studies have demonstrated that individuals with CVD experience worse HRQOL (77), increased depression (78) and physical disabilities (69). Disparities in HRQOL also exist across racial/ethnic (79) and socioeconomic (80) groups. Greater awareness of

the burdens of CVD risk could inform more meaningful prevention strategies among aging racial/ethnic minority populations.

The older adult population is also becoming more diverse, with the racial/ethnic minority population projected to surpass the white population by 2043 (81). Asian American and NHPI racial groups are projected to have the greatest increases in the older adult population aged 65 and older (81), however, evidence on HRQOL among Asian American and NHPI older adults, especially those with CVD. For example, Asian American adults reported better physical health but worse mental health than white adults, whereas NHPI adults reported worse physical and mental health among Medicare managed care members (79). However, despite reporting better physical functioning, this same study showed that Asian American adults reported fair or poor health more often than white adults (79). Similarly, Adia and colleagues (2020) found Asian American adults reported fair or poor health more often than white adults using the California Health Interview Survey, and there was marked differences in perceived health across Asian American disaggregated ethnic groups (26). Some explanations for these differences between studies include how HRQOL is operationalized (e.g., general health perceptions question versus calculated HRQOL score), how Asian American and NHPI groups are categorized (e.g., Asian American and NHPI groups combined into one category or only the Asian American group is included), the disease focus (e.g., cancer), and inclusion of different age categories. To our knowledge, the relationship between HRQOL and CVD has not been examined by disaggregated Asian American and NHPI ethnic groups, which could identify ethnic groups at increased risk of worse overall health.

The purpose of this study was to assess the relationship between CVD and HRQOL using the Veterans RAND 12 Item Health Survey (VR-12) among 10 disaggregated Asian American and NHPI ethnic groups compared to white Medicare Advantage enrollees using the Health Outcomes Survey (HOS). We expect that the associations between CVD and HRQOL will vary by Asian American and NHPI ethnic groups. Characterizing the association between HRQOL and CVD status by race/ethnicity would provide evidence on the effects of chronic conditions on everyday life and inform health promotion and healthy aging interventions targeted towards Asian American and NHPI communities.

Methods

Data Source

We used the Medicare HOS Limited Data Sets, a patient-reported outcomes survey administered by the Centers for Medicare & Medicaid Services (CMS). The purpose of the HOS is to collect data on Medicare Advantage enrollees to evaluate quality improvement efforts, health plan performance, and provide information to beneficiaries to make informed decisions (82). The HOS randomly samples individuals enrolled in Medicare Advantage plans from participating Medicare Advantage organizations with a minimum of 500 members. Surveys are mailed to respondents in Chinese, Spanish, and English. For respondents who do not complete the survey, they are contacted up to 10 times via telephone calls in Spanish and English.

Sample

Our study population included Medicare Advantage beneficiaries from the annual 2011-2015 HOS baseline cohorts. We included community-dwelling older adults who were 65 years or older at baseline and identified as Asian American, NHPI or white as well as non-Hispanic ethnicity. The study sample included two groups of beneficiaries, those who reported any CVD condition and those who did not report a CVD condition. We excluded respondents who had end stage renal disease, were in hospice or institutionalized and who did not answer of the questions about CVD or stroke. The final analytical sample included 618,154 respondents.

Dependent Variable

The primary health outcome was HRQOL and was operationalized using the Veterans RAND 12-Item Health Survey (VR-12). The VR-12 is comprised of 12 questions that summarize HRQOL into two scores, the physical component score (PCS) and mental component score (MCS). The HOS survey started collecting VR-12 data in 2006. The VR-12 was developed from the Veterans RAND 36-Item Health Survey (VR-36), that was originally adapted from the RAND 36-Item Short Form (SF-36) questionnaire (83). The main differences between the VR-12 and VR-36 surveys and the SF-36 survey are that the response categories were expanded for role limitations due to physical health and emotional problems and the change in health (83). The reliability and validity of the VR-12 has been tested among general patient populations, and a difference of 1- to 2-points has been reported to be clinically-meaningful (84,85).

The VR-12 questions cover eight domains, including perceptions of general health, physical functioning, limitations due to physical and emotional problems,

bodily pain, mental health, vitality, and social functioning (83) (Table 3.5.). The PCS and MCS scores are calculated using all questions and weights created from use of the VR-36 during the 1999 Large Health Survey of Veteran Enrollees (83). The scores are standardized to a 1990 non-institutionalized US population using a t-score transformation where a score of 50 represents the national average and the standard deviation is 10 points (86). The VR-12 uses the modified regression estimate (MRE) method that uses regression models to impute missing responses based on the patterns of missingness (87).

The PCS and MCS scores range from 0 to 100, where higher scores indicate better physical and mental functioning. Individuals with high PCS scores have no physical limitations or disabilities, high energy, and an excellent health rating (86). Individuals with high MCS have greater positive affect, no psychological distress, and no limitations due to emotional problems (86).

Primary Independent Variables

The primary independent variables were self-report of any CVD condition and race/ethnicity. Respondents were asked if they were ever diagnosed with coronary artery disease (CAD), congestive heart failure (CHF), myocardial infarction (MI), other heart conditions (problems with heart valves or the rhythm of their heartbeat), or stroke. Respondents who answered yes to any of the CVD conditions was categorized as has CVD. We conceptualized self-reported race/ethnicity as a social construct that represents the heterogeneity of cultural norms, sociopolitical history, and acculturation experiences of Asian American and NHPI groups (14,15). We also theorize that self-identification into these racial/ethnic groups are linked to

experiences of racism and discrimination that impact health outcomes and well-being (37). We categorized respondents into 11 racial/ethnic categories: non-Hispanic Asian Indian, non-Hispanic Chinese, non-Hispanic Filipino, non-Hispanic Japanese, non-Hispanic Korean, non-Hispanic Vietnamese, non-Hispanic Other Asian, Multiple-race Asian, non-Hispanic Native Hawaiian, non-Hispanic Other Pacific Islander, and non-Hispanic white. Multiple-race Asian included respondents who self-identified as an Asian group and another racial/ethnic group (including Hispanic, Black or African American, and white). Any respondent who identified as Native Hawaiian was categorized as Native Hawaiian. Other Pacific Islander included respondents who identified as Guamanian, Samoan, or Other Pacific Islander. Non-Hispanic white adults were included as the primary referent group for our analyses.

Covariates Selection

The Andersen and Newman's theory of health services utilization was used as a framework to understand the drivers of health care use and barriers that exist that prevent access to health care services (28). The main components of this behavioral model include predisposing characteristics such as age and sex, enabling resources such as income and health insurance, and need characteristics such as perceived and evaluated health status. This framework informed the selection of the model covariates. We hypothesized that predisposing characteristics, enabling resources, and need characteristics would independently impact use of health care services, and therefore be related to health care use associated with HRQOL among older adults with CVD. Covariates were also selected based on their known associations with CVD (52) and health disparities (53).

Predisposing characteristics included age, sex, education level and marital status. Age was categorized into young-old (65–74 years), middle-old (75–84 years), and old-old (85 years and over) groups. Marital status was dichotomized into married or not married (i.e., divorced/separated, widowed, and single and never married). Enabling resources included household income and whether respondents were enrolled in Medicare only or Medicare/Medicaid. Need characteristics included body mass index (BMI), diabetes, hypertension, smoking status, whether a proxy completed the survey, geographic region, and survey year. BMI was categorized using Asian-specific thresholds for Asian American groups and standard thresholds for NHPI and white groups. The Asian-specific BMI categories have lower cutoffs for overweight and obese groups (overweight = 23 – 27.5 kg/m^2 and obese ≥ 27.5 kg/m^2), compared to the standard BMI categories (overweight = 25 – 30 kg/m^2 and obese ≥ 30 kg/m^2) (49). Respondents were asked whether they were ever diagnosed with diabetes or hypertension. Respondents were asked about their smoking status and the response categories were every day, some days, not at all and don't know. Respondents were asked who completed the survey, and responses were grouped into no proxy (i.e., person to whom the survey was addressed) or proxy answered (i.e., family member or relative, friend, or professional caregiver to whom the survey was addressed). We adjusted for geographical region of the CMS plan and survey year to account for regional differences in Medicare Advantage organizations and differences in survey administration.

Statistical analysis

All analyses were conducted with RStudio, version 1.1.453 (55). We calculated frequencies and conducted bivariate analyses to describe characteristics of the total sample. The main comparison was PCS and MCS scores by racial/ethnic group and CVD status. Multivariate regression was conducted to estimate the PCS and MCS mean score differences and 95% confidence intervals (CI) in relation to CVD status and racial/ethnic group. The final model adjusted for predisposing characteristics, enabling resources, and need factors. We conducted regression analyses for the total sample to assess differences across Asian American and NHPI groups compared to white respondents. We created an interaction term between CVD status and racial/ethnic group to examine the moderating effect of race/ethnicity on HRQOL and CVD status. A statistically significant interaction term suggests that the relationship between HRQOL and CVD status is stronger for Asian American and NHPI ethnic groups than white adults. We also completed separate regression analyses that only included Asian American and NHPI groups, to assess differences between Asian American and NHPI groups.

Japanese individuals were chosen as the reference category because they were more likely to have report fewer CVD conditions (cite aim 1 paper) and lower rates of depressive symptoms (88) compared to other Asian American and NHPI groups. Furthermore, compared to other Asian American and NHPI groups, Japanese individuals have historically had a different trajectory of acculturation and have the highest percent of US born individuals and lower immigration rates (89). Therefore, we expect that Japanese individuals in the HOS are more acculturated (i.e., more years of life lived in the US, better English proficiency, and better overall health

because of familiarity with the US healthcare system) than other Asian American and NHPI groups.

Results

Sample Characteristics

In total, 618,154 respondents were included in the analysis (Table 3.1). About 5% of the sample identified as Asian American or NHPI. Most respondents were 65-74 years old, married, graduated from high school, did not have diabetes, had hypertension, did not smoke and were overweight. Among adults with CVD, 38% reported having CAD, 20% had CHF, 26% had MI, 61% had other heart conditions, and 21% reported having a stroke. Compared to respondents without CVD, adults with CVD were older and less educated, and reported greater rates of diabetes, hypertension, and being obese.

VR-12 PCS and MCS scores

Table 3.2 presents the VR-12 PCS and MCS scores by total sample, CVD status and race/ethnicity. Lower scores represent worse health and a difference of 1- to 2-points in scores is considered clinically meaningful. PCS scores were lower than MCS scores. The mean PCS score (standard deviation) was 41.1 (SD = 12.1) and the mean MCS score was 53.8 (SD = 9.9) for the total sample. PCS and MCS scores varied across Asian American and NHPI groups, and the majority of Asian American and NHPI groups had lower PCS and MCS scores in comparison to white adults. Table 3.6 shows VR-12 item characteristics for the total sample and by CVD status.

PCS and MCS scores by CVD status

As expected, PCS and MCS scores were lower among adults with CVD compared to adults without CVD (Table 3.2). Regardless of CVD status, compared to white adults, the majority of Asian American and NHPI groups reported significantly lower PCS and MCS scores. The two exceptions were Japanese and Korean adults who reported higher PCS scores than white adults. Among Asian American adults with CVD, multiple race Asian adults reported the lowest PCS scores and Vietnamese adults reported the lowest MCS scores. Other Pacific Islander adults reported the lowest PCS and MCS scores compared to Native Hawaiian, white and Asian American adults. There were notable differences in the magnitude of scores across ethnic groups, with a range of 6 PCS points between Korean and Other Pacific Islander adults and range of 8 MCS points between Japanese and Other Pacific Islander adults.

Multivariate model for total sample

Table 3.3 shows the results of the adjusted regression models assessing the differences in PCS and MCS scores across Asian American and NHPI groups compared to white respondents. Negative estimates represent lower scores and worse health. After adjustment, having CVD was significantly associated with a decrease of 4.94 PCS (95% CI = -5.00, -4.88) and 1.84 MCS (95% CI = -1.90, -1.78) points compared to adults without CVD. Compared to white adults, Asian American and NHPI ethnic groups had significantly higher PCS scores, except for Asian Indian adults. For MCS scores, Chinese, Korean, Multiple-race Asian and Other Pacific Islander groups had significantly lower MCS scores compared to white adults, whereas Filipino adults had higher MCS scores. We observed the greatest PCS mean

score difference (2.56 points, 95% CI = 2.21, 2.92) in Filipino adults and the greatest MCS mean score difference (-0.96 points, 95% CI = -1.40, -0.52) in Multiple race Asian adults.

For the moderating effect of race/ethnicity (interaction term), the direction of the associations between PCS and MCS and CVD remained the same, but the magnitude of mean score difference increased for MCS. For the relationship between PCS and CVD status, the interaction terms for Asian Indian, Japanese, Korean, Vietnamese, Other Asian, and Other Pacific Islander groups were statistically significant. This suggests that having CVD in these ethnic groups were more likely to report better PCS scores than white adults. For the MCS, except for Japanese and Native Hawaiian adults, Asian American and Other Pacific Islander adults with CVD were more likely to report worse MCS scores.

Multivariate model for Asian American and NHPI sample

Table 3.4 shows the adjusted regression models for the Asian American and NHPI sample only (white adults are not included), to examine the differences in PCS and MCS scores between Asian American and NHPI ethnic groups compared to Japanese adults. After adjustment, having CVD was associated with significantly lower PCS (mean score difference = -3.87; 95% CI = -4.66, -3.07) and MCS (mean score difference = -1.70; 95% CI = -2.52, -0.88) scores. Most Asian American and NHPI ethnic groups had lower PCS and MCS scores compared to Japanese adults but statistically significant differences varied by ethnic group. This indicates that there is heterogeneity in PCS and MCS scores among the Asian American and NHPI sample. For example, other Pacific Islanders had a PCS score that was 2.37 points (95% CI =

-3.07, -1.67) and MCS score than was 2.08 (95% CI = -2.80, -1.36) points lower than Japanese adults.

For PCS, the interaction term for Chinese, Multiple race Asian, and Native Hawaiian adults were statistically significant. This suggests that having CVD in these ethnic groups was associated with worse PCS scores than Japanese adults. Compared to Japanese adults with CVD, the majority of Asian American and Other Pacific Islander adults with CVD had significantly worse MCS scores, except for Native Hawaiian adults.

Discussion

This study provides new evidence evaluating the association between HRQOL and CVD status among disaggregated Asian American and NHPI older adults enrolled in Medicare Advantage health plans. Overall, adults who self-reported a CVD condition had lower PCS and MCS scores than adults without CVD. We observed notable differences in the magnitude of PCS and MCS scores across Asian American and NHPI ethnic groups, indicating differences in HRQOL when data are disaggregated. After adjusting for covariates, compared to white adults, Asian American and NHPI ethnic groups had better PCS but worse MCS, though the differences were not statistically significant for all ethnic groups.

Our results indicate that having CVD was consistently associated with worse HRQOL, and having CVD impacted physical health more than mental health. For example, having CVD decreased PCS scores by 5 points but only decreased MCS scores by 2 points. The trend with PCS scores might be explained in part because

individuals who suffer from a CVD event could experience a greater daily burden from physical disabilities and comorbidities than mental health (90). Additionally, the need characteristics we included in the analyses such as diabetes and BMI may be more strongly associated with changes in physical than mental health. The estimated prevalence of adults aged ≥20 years with CVD was 48% in 2016 (121.5 million people) (66), and understanding the acute and chronic impacts of CVD conditions and stroke on HRQOL is increasingly important in order to anticipate and address the needs of the aging adult population.

We found distinct patterns in PCS and MCS scores by disaggregated Asian American and NHPI ethnic groups. Our findings indicate that some Asian American groups, including Vietnamese, Other Asian and Multiple race Asian adults, and Other Pacific Islander adults may be at greater risk for worse HRQOL, given that a score difference of 1 to 2 points have demonstrated meaningful clinical differences in general patient populations (84,85). CMS previously reported similar findings where 25% of Other Asian and 42% of Samoan adults screened positive for depression, and 26% of Other Asian and 36% of Other Pacific Islander adults reported having 14 to 30 days with activity limitations in the past 30 days (91). We expect that the Other Asian category includes more recent immigrants to the US or other refugees from the Vietnam War like Cambodian or Laotian ethnic groups , which would potentially explain the worse HRQOL. Multiple race Asians are the fastest growing group within the Asian American racial category (92), and may be a population worth examining in detail in future research. The variation in HRQOL across Asian American and NHPI groups is likely multifactorial, and could be explained by the diverse histories,

cultures, and languages of these communities that subsequently impact health behaviors and health outcomes (13,93). For example, differences in health status for a Vietnamese American adult in comparison to a Japanese American adult could be explained in part by lower socioeconomic position, lower English language proficiency, and discriminatory experiences related to the context of migration (e.g., Vietnam War). Assari and Kumar (2018) reported differences in overall self-rated health across Asian ethnic groups in the National Asian American Survey, which is consistent with our results that there were differences by Asian American and NHPI ethnic groups (94). The authors also reported differences in the effect of the socioeconomic factors (e.g., income, education and employment) on self-rated health by Asian ethnic groups (94). Another study found that limited-English proficient adults were more likely to report poorer health and worse health care access (e.g., having delayed care and not have a usual source of care) compared to adults who were English proficient (95). The determinants of HRQOL are complex and require that future interventions and policies evaluate the intersectional nature of identities.

Compared to white respondents, we found that the majority of Asian American and NHPI groups had worse mental health but better physical health, although not all differences were statistically significant. This finding may be partially explained by the predisposing, enabling and need covariates. We previously reported that Asian American and NHPI ethnic groups had greater prevalence of being overweight or obese, diabetes and hypertension (cite aim 1 paper). Asian American and NHPI groups had lower HRQOL scores compared to white adults (Table 3.2). However, after we adjusted for covariates, we observed higher PCS

scores among Asian American and NHPI groups compared to white adults. Thus, perhaps the varying PCS scores among Asian American and NHPI adults were more related to being overweight or obese, diabetes and hypertension than having a CVD condition. The younger age of Asian American and NHPI ethnic groups compared to white adults might explain the better PCS scores (cite aim 1 paper). Prior research also suggests that there may be a healthy migrant effect, where Asian American immigrants who have lived fewer years in the US had lower risk of disabilities compared to native-born individuals and immigrants who have lived longer in the US (96). The consistently lower MCS scores could be attributable to trauma experience pre-immigration, for instance, the refugee experience of the Vietnam War (20). In contrast to our findings, prior research found that Asian Americans had significantly better MCS scores compared to white respondents (80). However, this difference might be explained because the study did not examine HRQOL by Asian American ethnic groups and the variation in MCS scores could have been masked by the aggregate grouping. Examining disaggregated data for Asian America and NHPI groups could provide more relevant information on the relationship between CVD-related behaviors and HRQOL, in order to focus interventions for high-risk groups.

When we included an interaction term to test the moderating effect of race/ethnicity, there was a stronger relationship with having worse mental health among Asian American and NHPI groups with CVD than their white counterparts. These findings demonstrate a need to focus on mental health among this population and that the response to improving HRQOL among Asian American and NHPI ethnic groups is not one size fits all. Taken together, there is a clear need for tailored

programming and interventions within the growing Asian American and NHPI older adult and racial/ethnic minority populations. However, funding from the National Institutes of Health (NIH) for clinical research in Asian American and NHPI populations has not increased over two decades (19). Furthermore, existing interventions on CVD risk factors and disease management are rarely focused on older adults (97), including Asian Americans and NHPIs, and reducing health disparities (98,99).

Given the projected growth of Asian American and NHPI older adults and the growing diversity in the US (100), focusing efforts on racial/ethnic minority populations is essential. A potential area of focus for promoting healthy aging among Asian American and NHPI adults is improving mental health. Asian American and NHPI groups experience disparities in access to mental health care (101) and health services utilization (102), and intervention efforts are required to address current disparities and to keep them from widening as the population increases. Framing interventions around an integrated care approach could improve prevention and treatment of mental and physical health problems (e.g., older adult who had a stroke and has depression) for Asian American and NHPI older adults, as well as other elderly populations (103,104). For example, an intervention focusing on improving positive psychological well-being could subsequently improve perceptions of overall health, and thus CVD outcomes and management of CVD risk factors among older adults (105). Additionally, interventions must consider the cultural traditions and identities of Asian American and NHPI populations to provide culturally- and

linguistically-relevant information and care for certain populations and increase the use of mental health services (106).

When considering our results, there are some limitations to note. First, the HOS data is self-reported, which may have resulted in higher HRQOL scores and underreporting of CVD due to the desire to report better health outcomes. Second, the HOS is only administered in English, Spanish, and Chinese (mail-only survey), so the HOS could be biased towards respondents who were more proficient in English and against those with limited English proficiency. The VR-12 instrument has not been validated for limited English proficient individuals (84,85). Therefore, the VR-12 scores calculated from the HOS survey may not be equivalent across racial/ethnic groups (i.e., VR-12 scores for HRQOL may not be a meaningful comparison). Third, the VR-12 scores in the HOS also uses the scoring algorithm that normalizes the score to a 1990 US population standard (107), which is not representative of the current population composition and distribution. There are updated scoring algorithms that normalizes VR-12 scores to a 1998 US population standard and using the 2000 to 2002 Medical Expenditure Panel Survey (MEPS), however the first algorithm is proprietary and the second algorithm was based on the SF-12 questionnaire (107). Nevertheless, the VR-12 instrument has been utilized for the HOS since 2006 (107) and measures several domains of HRQOL, including general health perceptions, that provides a comprehensive summary of how CVD conditions are impacting health in older age. Fourth, the HOS baseline data that we analyzed is cross-sectional. We are unable to infer causation and directionality in the relationship

between HRQOL and CVD and we rely on self-report information that may be biased.

Our study had several strengths that have important implications for the Asian American and NHPI older adult population, particularly those with CVD. Our study includes a large, nationally representative sample of older adults enrolled in Medicare Advantage plans and has disaggregated data for eight Asian American and two NHPI groups. The large size of Asian American and NHPI ethnic groups allowed us to estimate HRQOL among adults enrolled in Medicare Advantage plans, who are a gradually increasing group in Medicare (108). Few other data sources provide the sample size and variation necessary to conduct a disaggregated Asian American and NHPI ethnic group study like what we present in this analysis.

Our study suggests that attention to mental health for Asian American and NHPI older adults could be important for the equitable realization of healthy aging. Given the unique needs of older adults, understanding mental health could provide context on health behaviors that could inform how to best tailor interventions and healthcare services to improve health for racial/ethnic minority older adults. Based on these findings, future studies should utilize longitudinal data that could provide information on adverse events that impact HRQOL and how HRQOL is changing in the context of these events and aging. For instance, the impact of acute symptoms from a stroke might impact HRQOL differently than chronic symptoms related to other heart conditions like heart valve problems. Additionally, future epidemiological studies and interventions should prioritize disaggregated analyses to more accurately

evaluate the health status and determinants of health among Asian American and NHPI older adults.

Table 3.1. Descriptive characteristics of study population, by total sample and CVD status, Medicare Health Outcomes Survey, 2011-2015

Characteristics	Total Sample	CVD Status		
		Has CVD [1]	No CVD	*p*-value [2]
Number of participants	618,154	209,283 (33.9)	408,871 (66.1)	
CVD condition, n (%)				
Coronary artery disease	79,790 (12.9)	79,790 (38.1)	-	
Congestive heart failure	42,089 (6.8)	42,089 (20.1)	-	
Myocardial infarction	55,295 (9.0)	55,295 (26.4)	-	
Stroke	43,042 (7.0)	43,042 (20.6)	-	
Other heart conditions	128,576 (20.8)	128,576 (61.4)	-	
Predisposing characteristics				
Mean age (SD), years	74.2 (6.9)	75.6 (7.2)	73.5 (6.7)	< .001
Age group, n (%)				
65 - 74 years	360,256 (58.3)	104,134 (49.8)	256,122 (62.6)	
75 - 84 years	198,549 (32.1)	77,930 (37.2)	120,619 (29.5)	
85 years and older	59,349 (9.6)	27,219 (13.0)	32,130 (7.9)	< .001
Sex, n (%)				
Female	348,776 (56.4)	103,604 (49.5)	245,172 (60.0)	
Male	269,378 (43.6)	105,679 (50.5)	163,699 (40.0)	< .001
Race/ethnicity, n (%)				
Asian Indian	2,739 (0.4)	735 (0.4)	2,004 (0.5)	
Chinese	6,016 (1.0)	1,418 (0.7)	4,598 (1.1)	
Filipino	5,391 (0.9)	1,303 (0.6)	4,088 (1.0)	
Japanese	3,474 (0.6)	834 (0.4)	2,640 (0.6)	
Korean	1,668 (0.3)	278 (0.1)	1,390 (0.3)	
Vietnamese	1,931 (0.3)	440 (0.2)	1,491 (0.4)	
Other Asian	1,342 (0.2)	325 (0.2)	1,017 (0.2)	
Multiple-race Asian	3,241 (0.5)	976 (0.5)	2,265 (0.6)	
Native Hawaiian	2,118 (0.3)	720 (0.3)	1,398 (0.3)	
Other Pacific Islander	2,519 (0.4)	784 (0.4)	1,735 (0.4)	
White	587,715 (95.1)	201,470 (96.3)	386,245 (94.5)	< .001
Marital Status, n (%)				
Married	362,344 (59.0)	120,013 (57.7)	242,331 (59.6)	
Not Married	252,122 (41.0)	88,027 (42.3)	164,095 (40.4)	< .001
Education, n (%)				
Less than high school diploma	85,694 (14.0)	33,806 (16.3)	51,888 (12.8)	
High school graduate or GED	212,419 (34.7)	71,584 (34.5)	140,835 (34.8)	
Some college or two-year degree	163,459 (26.7)	54,787 (26.4)	108,672 (26.8)	
Four-year degree or more	150,830 (24.6)	47,135 (22.7)	103,695 (25.6)	< .001

Enabling Resources				
Household income, n (%)				
Less than $10, 000	44,575 (7.9)	17,147 (8.19)	27,428 (6.71)	
$10,000 - 19,999	98,933 (17.5)	38,049 (18.2)	60,884 (14.9)	
$20,000 - 29,999	98,465 (17.4)	35,458 (16.9)	63,007 (15.4)	
$30,000 - 49, 999	131,306 (23.2)	43,723 (20.9)	87,583 (21.4)	
$50,000 or more	135,513 (24.0)	40,156 (19.2)	95,357 (23.3)	
Don't know	56,891 (10.1)	8,728 (8.95)	38,163 (9.33)	< .001
Medicare/Medicaid, n (%)	74,021 (12.0)	30,417 (14.5)	43,604 (10.7)	< .001
Healthcare need factors				
Diabetes, n (%)	140,732 (22.9)	63,538 (30.5)	77,194 (19.0)	< .001
Hypertension, n (%)	391,281 (63.5)	158,761 (76.1)	232,520 (57.1)	< .001
Smoking status, n (%)				
Not at all	555,099 (90.4)	188,301 (90.6)	366,798 (90.3)	
Every day	39,333 (6.4)	12,988 (6.2)	26,345 (6.5)	
Some days	17,260 (2.8)	57,69 (2.8)	11,491 (2.8)	
Don't know	2,384 (0.4)	796 (0.4)	1,588 (0.4)	< .001
BMI category, n (%) [3]				
Normal	184,448 (30.6)	56,485 (27.6)	127,963 (32.2)	
Underweight	11,133 (1.8)	3,712 (1.8)	7,421 (1.9)	
Overweight	235,356 (39.1)	78,743 (38.5)	156,613 (39.3)	
Obese	171,204 (28.4)	65,412 (32.0)	105,792 (26.6)	< .001
Proxy completed survey, n (%)	49,830 (8.2)	23,125 (11.2)	26,705 (6.6)	< .001

Abbreviations: *BMI* body mass index; *CVD* cardiovascular disease

Note: Column percentages are calculated and may not total 100% due to rounding.

[1] This category includes respondents who answered *yes* to having angina pectoris or coronary artery disease, congestive heart failure, myocardial infarction, or other heart conditions (e.g., problems with heart valves or the rhythm of their heartbeat), or stroke.
[2] *P*-values reported compare those who reported not having been diagnosed with any CVD to those with CVD. *P*-values <.05 were considered statistically significant.
[3] Asian-specific BMI thresholds (overweight = 23 – 27.5 kg/m^2, obese ≥ 27.5 kg/m^2) were applied to Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian, and Multiple-race Asian groups. Standard BMI thresholds (overweight = 25 – 30 kg/m^2, obese ≥ 30 kg/m^2) were applied white, Native Hawaiian, and Other Pacific Islander groups.

Table 3.2. VR-12 physical and mental component scores, by total sample, CVD status and racial/ethnic group, Medicare Health Outcomes Survey, 2011-2015

	Total Sample		CVD status			
			Has CVD		No CVD	
	Mean PCS score (SD)	Mean MCS score (SD)	Mean PCS score (SD)	Mean MCS score (SD)	Mean PCS score (SD)	Mean MCS score (SD)
Total Sample	41.1 (12.1)	53.8 (9.9)	36.4 (12.3)	52.1 (11.0)	43.5 (11.2)	54.6 (9.2)
White (reference)	41.1 (12.1)	53.9 (9.9)	36.5 (12.4)	52.2 (11.0)	43.5 (11.3)	54.8 (9.2)
Asian Indian	40.5 (11.1)	52.2 (10.7)	36.5 (11.4)	49.0 (11.8)	42.0 (10.7)	53.4 (10.0)
Chinese	41.4 (10.9)	49.9 (10.8)	36.0 (11.0)	46.3 (11.9)	43.0 (10.3)	51.0 (10.2)
Filipino	40.7 (11.0)	51.3 (10.1)	36.0 (11.0)	48.6 (11.0)	42.2 (10.5)	52.1 (9.7)
Japanese	43.2 (11.1)	53.6 (9.7)	39.0 (11.3)	52.1 (10.8)	44.5 (10.7)	54.1 (9.3)
Korean	43.6 (9.8)	50.8 (9.8)	39.2 (10.4)	46.9 (10.8)	44.4 (9.4)	51.6 (9.4)
Vietnamese	39.5 (10.2)	49.0 (9.9)	35.4 (10.3)	45.2 (9.9)	40.6 (9.9)	50.1 (9.6)
Other Asian	39.5 (10.9)	49.2 (11.2)	35.5 (11.5)	46.1 (11.8)	40.8 (10.4)	50.2 (10.9)
Multiple race Asian	39.7 (11.1)	50.2 (11.1)	34.9 (11.2)	47.6 (11.9)	41.9 (10.4)	51.4 (10.4)
Native Hawaiian	40.7 (11.7)	51.4 (11.1)	35.7 (11.7)	48.7 (12.2)	43.2 (10.8)	52.7 (10.3)
Other Pacific Islander	37.3 (11.7)	47.6 (12.1)	33.3 (11.7)	44.2 (12.3)	39.2 (11.4)	49.1 (11.6)
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Abbreviations: *CVD* cardiovascular disease; *MCS* mental component score; *PCS* physical component score; *SD* standard deviation; *VR-12* Veteran's RAND 12-item survey

Note: The PCS and MCS scores range from 0 to 100, where higher scores indicate better physical and mental health functioning. Dark gray boxes represent lower scores (worse health) and light gray boxes represent higher scores (better health) than whites. ANOVA tests were conducted to test for differences in PCS and MCS scores by race/ethnicity. Non-Hispanic white is the reference group.

Table 3.3. Adjusted PCS and MCS Mean Score Differences for the study population, Medicare Health Outcomes Survey, 2011-2015

	PCS mean score difference	*95% CI*	*MCS mean score difference*	*95% CI*
Intercept	56.21		60.88	
CVD status				
No	Reference		Reference	
Yes	-4.94	-5.00, -4.88	-1.84	-1.90, -1.78
Race/ethnicity				
White	Reference		Reference	
Asian Indian	-0.06	-0.55, 0.43	0.31	-0.13, 0.76
Chinese	2.51	2.18, 2.84	-0.56	-0.86, -0.26
Filipino	2.56	2.21, 2.92	0.40	0.08, 0.73
Japanese	2.17	1.74, 2.60	0.17	-0.22, 0.56
Korean	2.16	1.58, 2.75	-0.71	-1.24, -0.17
Vietnamese	1.76	1.18, 2.35	-0.32	-0.85, 0.21
Other Asian	1.71	0.99, 2.42	-0.53	-1.18, 0.11
Multiple-race Asian	0.74	0.26, 1.23	-0.96	-1.40, -0.52
Native Hawaiian	2.25	1.64, 2.86	-0.31	-0.86, 0.24
Other Pacific Islander	1.21	0.64, 1.77	-0.80	-1.31, -0.29
Race/ethnicity × CVD status				
White × has CVD	Reference		Reference	
Asian Indian × has CVD	1.44	0.49, 2.38	-1.79	-2.64, -0.93
Chinese × has CVD	0.50	-0.17, 1.17	-1.89	-2.50, -1.28
Filipino × has CVD	0.63	-0.07, 1.32	-1.13	-1.76, -0.50
Japanese × has CVD	1.50	0.64, 2.35	0.11	-0.66, 0.89
Korean × has CVD	2.03	0.61, 3.44	-2.32	-3.60, -1.04
Vietnamese × has CVD	1.50	0.29, 2.71	-2.36	-3.46, -1.27
Other Asian × has CVD	1.98	0.55, 3.40	-1.52	-2.81, -0.23
Multiple-race Asian × has CVD	0.03	-0.83, 0.90	-1.05	-1.83, -0.27
Native Hawaiian × has CVD	-0.42	-1.44, 0.60	-0.62	-1.55, 0.31
Other Pacific Islander × has CVD	1.31	0.32, 2.30	-2.28	-3.18, -1.38
Age categories				
65 - 74 years	Reference		Reference	
75 - 84 years	-2.63	-2.69, -2.57	0.42	0.36, 0.48
85 years or more	-6.71	-6.82, -6.60	-0.21	-0.31, -0.12
Sex				
Male	Reference		Reference	
Female	-1.38	-1.44, -1.32	-0.47	-0.53, -0.42
Education				

Less than High School	Reference		Reference	
HS/GED	0.73	0.64, 0.82	1.25	1.17, 1.33
Some College	1.04	0.94, 1.14	1.51	1.42, 1.60
College+	2.11	2.00, 2.21	1.64	1.54, 1.73
Marital Status				
Married	Reference		Reference	
Not Married	0.37	0.31, 0.44	-0.58	-0.64, -0.52
Medicaid				
Medicare only	Reference		Reference	
Medicare/Medicaid	-3.87	-3.97, -3.76	-2.37	-2.46, -2.28
Income				
Less than $10,000	-4.34	-4.48, -4.21	-3.51	-3.63, -3.38
$10,000 - $19,999	-3.98	-4.09, -3.88	-2.76	-2.85, -2.66
$20,000- $29,999	-3.12	-3.22, -3.03	-1.94	-2.03, -1.86
$30,000- $49,999	-1.82	-1.90, -1.73	-1.03	-1.11, -0.95
$50,000 or more	Reference		Reference	
Don't know	-2.72	-2.83, -2.61	-1.26	-1.36, -1.16
Diabetes				
No	Reference		Reference	
Yes	-2.72	-2.79, -2.65	-1.29	-1.36, -1.23
Hypertension				
No	Reference		Reference	
Yes	-1.98	-2.04, -1.92	-0.38	-0.43, -0.32
Smoking status				
Never smoked	Reference		Reference	
Smoke every day	-2.76	-2.88, -2.65	-1.78	-1.88, -1.67
Smoke some days	-2.04	-2.21, -1.87	-1.92	-2.07, -1.76
Don't know	0.23	-0.23, 0.69	-2.70	-3.12, -2.28
BMI category [1]				
Normal	Reference		Reference	
Underweight	-2.87	-3.08, -2.65	-1.88	-2.07, -1.68
Overweight	-1.03	-1.10, -0.96	0.31	0.25, 0.37
Obese	-5.03	-5.11, -4.96	-0.16	-0.22, -0.09
Proxy completed survey				
No	Reference		Reference	
Yes	-5.81	-5.92, -5.70	-4.83	-4.93, -4.73

Abbreviations: *BMI* body mass index; *CI* confidence interval *CVD* cardiovascular disease; *MCS* mental component score; *PCS* physical component score

Note: A negative mean score difference indicates worse health and a positive mean score difference indicates better health. Bold values denote statistical significance at the $p < 0.05$ level. This analysis adjusted for predisposing factors (sex, age, marital status, education level), enabling factors (income and Medicaid eligibility), and need factors (hypertension, diabetes, smoking status, BMI, whether a proxy completed the survey, Medicare Advantage Organization region).

[1] Asian-specific BMI thresholds (overweight = 23 – 27.5 kg/m^2, obese ≥ 27.5 kg/m^2) were applied to Asian American ethnic groups. Standard BMI thresholds (overweight = 25 – 30 kg/m^2, obese ≥ 30 kg/m^2) were applied to white and Native Hawaiian and Other Pacific Islander groups.

Table 3.4. Adjusted PCS and MCS Mean Score Differences for Asian American and NHPI groups, Medicare Health Outcomes Survey, 2011-2015

	PCS mean score difference	*95% CI*	*MCS mean score difference*	*95% CI*
Intercept	54.59		58.61	
CVD status				
No	Reference		Reference	
Yes	-3.87	-4.66, -3.07	-1.70	-2.52, -0.88
Race/ethnicity				
Japanese	Reference		Reference	
Asian Indian	-2.23	-2.88, -1.57	-0.49	-1.16, 0.18
Chinese	-0.38	-0.90, 0.14	-1.42	-1.95, -0.88
Filipino	-0.43	-0.96, 0.10	-0.16	-0.71, 0.38
Korean	-0.34	-1.03, 0.36	-1.89	-2.61, -1.17
Vietnamese	-1.87	-2.59, -1.16	-1.56	-2.30, -0.83
Other Asian	-1.62	-2.42, -0.82	-1.80	-2.63, -0.98
Multiple-race Asian	-1.76	-2.37, -1.14	-1.50	-2.13, -0.87
Native Hawaiian	-0.77	-1.46, -0.07	-0.52	-1.24, 0.20
Other Pacific Islander	-2.37	-3.07, -1.67	-2.08	-2.80, -1.36
Race/ethnicity × CVD status				
Japanese × has CVD	Reference		Reference	
Asian Indian × has CVD	-0.16	-1.34, 1.03	-1.82	-3.04, -0.60
Chinese × has CVD	-1.11	-2.12, -0.10	-2.01	-3.05, -0.97
Filipino × has CVD	-0.85	-1.88, 0.17	-1.32	-2.37, -0.26
Korean × has CVD	0.54	-1.00, 2.07	-2.29	-3.87, -0.71
Vietnamese × has CVD	0.11	-1.26, 1.49	-2.52	-3.93, -1.10
Other Asian × has CVD	0.42	-1.12, 1.96	-1.60	-3.20, -0.01
Multiple-race Asian	-1.62	-2.75, -0.50	-1.23	-2.40, -0.07
Native Hawaiian × has CVD	-2.05	-3.28, -0.81	-0.76	-2.04, 0.51
Other Pacific Islander × has CVD	-0.23	-1.44, 0.99	-2.51	-3.77, -1.26
Age categories				
65 - 74 years	Reference		Reference	
75 - 84 years	-2.47	-2.74, -2.20	-0.36	-0.64, -0.08
85 years or more	-6.88	-7.35, -6.41	-1.76	-2.25, -1.28
Sex				
Male	Reference		Reference	
Female	-1.79	-2.05, -1.53	-0.24	-0.51, 0.03
Education				
Less than High School	Reference		Reference	
HS/GED	0.28	-0.08, 0.64	1.4	1.03, 1.77
Some College	0.44	0.04, 0.84	1.41	1.00, 1.82
College+	1.1	0.72, 1.47	2.04	1.65, 2.43

Marital Status				
Married	Reference		Reference	
Not Married	0.11	-0.16, 0.39	-0.19	-0.47, 0.10
Medicaid				
Medicare only	Reference		Reference	
Medicare/Medicaid	-3.17	-3.48, -2.85	-2.22	-2.54, -1.90
Income				
Less than $10,000	-2.88	-3.33, -2.44	-3.71	-4.17, -3.25
$10,000 - $19,999	-2.97	-3.39, -2.55	-3.15	-3.58, -2.72
$20,000- $29,999	-2.52	-2.97, -2.07	-2.19	-2.65, -1.72
$30,000- $49,999	-1.39	-1.81, -0.98	-1.58	-2.01, -1.16
$50,000 or more	Reference		Reference	
Don't know	-2.42	-2.88, -1.97	-1.75	-2.21, -1.29
Diabetes				
No	Reference		Reference	
Yes	-2.34	-2.61, -2.08	-1.48	-1.75, -1.21
Hypertension				
No	Reference		Reference	
Yes	-1.52	-1.78, -1.25	-0.59	-0.86, -0.31
Smoking status				
Never smoked	Reference		Reference	
Smoke every day	-0.52	-1.13, 0.09	-1.23	-1.85, -0.60
Smoke some days	-0.69	-1.48, 0.09	-1.9	-2.70, -1.09
Don't know	1.74	0.59, 2.89	-2.47	-3.65, -1.29
BMI category [1]				
Normal	Reference		Reference	
Underweight	-1.65	-2.27, -1.03	-2.43	-3.07, -1.79
Overweight	-0.53	-0.81, -0.25	0.02	-0.27, 0.30
Obese	-3.09	-3.44, -2.74	-0.45	-0.81, -0.09
Proxy completed survey				
No	Reference		Reference	
Yes	-2.9	-3.23, -2.58	-1.32	-1.66, -0.99

Abbreviations: *BMI* body mass index; *CI* confidence interval *CVD* cardiovascular disease; *MCS* mental component score; *NHPI* Native Hawaiian and Other Pacific Islander; *PCS* physical component score

Note: A negative mean score difference indicates worse health and a positive mean score difference indicates better health. Bold values denote statistical significance at the $p < 0.05$ level. This analysis adjusted for predisposing factors (sex, age, marital status, education level), enabling factors (income and Medicaid eligibility), and need factors (hypertension, diabetes, smoking status, BMI, whether a proxy completed the survey, Medicare Advantage Organization region).

[1] Asian-specific BMI thresholds (overweight = 23 – 27.5 kg/m^2, obese ≥ 27.5 kg/m^2) were applied to Asian American ethnic groups. Standard BMI thresholds (overweight = 25 – 30 kg/m^2, obese ≥ 30 kg/m^2) were applied to Native Hawaiian and Other Pacific Islander groups.

Table 3.5. Supplemental - VR-12 questions

Domain	Question	Response categories
General health (1 question)	In general, would you say your health is:	Excellent; very good; good, fair; poor
Physical functioning (2 questions)	The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? - Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf. - Climbing several flights of stairs.	Yes, limited a lot; Yes, limited a little; No, not limited at all
Limitations due to physical problems (2 questions)	During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health? - Accomplished less than you would like. - Were limited in the kind of work or other activities.	No, none of the time; Yes, a little of the time; Yes, some of the time; Yes, most of the time; Yes, all of the time.
Limitations due to emotional problems (2 questions)	During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? - Accomplished less than you would like. - Didn't do work or other activities as carefully as usual.	No, none of the time; Yes, a little of the time; Yes, some of the time; Yes, most of the time; Yes, all of the time.
Bodily pain (1 question)	During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	Not at all; a little bit; moderately; quite a bit; extremely
Mental health (2 questions)	- How much of the time during the past 4 weeks have you felt calm and peaceful? - How much of the time during the past 4 weeks have you felt downhearted and blue?	All of the time; most of the time; a good bit of the time; some of the time; a little of the time; none of the time
Vitality (1 question)	How much of the time during the past 4 weeks have did you have a lot of energy?	All of the time; most of the time; a good bit of the time; some of the time; a little of the time; none of the time
Social functioning (1 question)	During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?	All of the time; most of the time; a good bit of the time; some of the time; a little of the time; none of the time

Abbreviations: *VR-12* Veteran's RAND 12-item survey

Table 3.6. Supplemental - VR-12 item characteristics, by total sample and CVD status, Medicare Health Outcomes Survey, 2011-2015

	Total Sample	CVD Status		
VR-12 items		Has CVD	No CVD	*p*-value [1]
	618, 154	209, 283 (33.9)	408, 871 (66.1)	
General health, n (%)				
Excellent	55, 168 (9.0)	6, 978 (3.4)	48, 190 (11.9)	
Very good	199, 953 (32.8)	45, 537 (22.1)	154, 416 (38.2)	
Good	231, 961 (38.0)	85, 856 (41.6)	146, 105 (36.2)	
Fair	100, 424 (16.4)	53, 326 (25.8)	47, 098 (11.7)	
Poor	23, 031 (3.8)	14, 692 (7.1)	8, 339 (2.1)	< .001
Moderate activities, n (%)				
Limited a lot	102, 937 (16.8)	54, 030 (26.1)	48, 907 (12.1)	
Limited a little	193, 139 (31.6)	75, 869 (36.7)	117, 270 (29.0)	
Not limited	315, 344 (51.6)	76, 968 (37.2)	238, 376 (58.9)	< .001
Climbing several flights of stairs, n (%)				
Limited a lot	140, 669 (23.4)	71, 963 (35.4)	68, 706 (17.3)	
Limited a little	209, 217 (34.8)	75, 698 (37.2)	133, 519 (33.6)	
Not limited	251, 404 (41.8)	55, 808 (27.4)	195, 596 (49.2)	< .001
Physical health limiting amount accomplished, n (%)				
No, none of the time	249, 312 (40.8)	56, 495 (27.3)	192, 817 (47.7)	
Yes, a little of the time	137, 126 (22.4)	44, 601(21.6)	92, 525 (22.9)	
Yes, some of the time	125, 878 (20.6)	52, 831 (25.5)	73, 047 (18.1)	
Yes, most of the time	67, 821 (11.1)	35, 298 (17.1)	32, 523 (8.0)	
Yes, all of the time	31, 194 (5.1)	17, 707 (8.6)	13, 487 (3.3)	< .001
Physical health limiting the kind of activities, n (%)				
No, none of the time	254, 884 (42.2)	57, 087 (28.0)	197, 797 (49.5)	
Yes, a little of the time	130, 743 (21.6)	42, 649 (20.9)	88, 094 (22.0)	
Yes, some of the time	118, 636 (19.7)	50, 221 (24.6)	68, 415 (17.1)	
Yes, most of the time	65, 795 (10.9)	34, 668 (17.0)	31, 127 (7.8)	
Yes, all of the time	33, 789 (5.6)	19, 615 (9.6)	14, 174 (3.5)	< .001
Emotional problems limiting amount accomplished, n (%)				
No, none of the time	421, 261 (68.8)	125, 429 (60.5)	295, 832 (73.0)	
Yes, a little of the time	90, 416 (14.8)	33, 836 (16.3)	56, 580 (14.0)	
Yes, some of the time	63, 334 (10.3)	27, 691 (13.4)	35, 643 (8.8)	
Yes, most of the time	26, 899 (4.4)	14, 151 (6.8)	12, 748 (3.1)	
Yes, all of the time	10, 836 (1.8)	6, 144 (3.0)	4, 692 (1.2)	< .001

Emotional problems limiting carefulness, n (%)				
No, none of the time	433, 357 (71.7)	129, 892 (63.6)	303, 465 (75.8)	
Yes, a little of the time	83, 007 (13.7)	31, 926 (15.6)	51, 081 (12.8)	
Yes, some of the time	54, 597 (9.0)	24, 456 (12.0)	30, 141 (7.5)	
Yes, most of the time	22, 957 (3.8)	12, 041 (5.9)	10, 916 (2.7)	
Yes, all of the time	10, 680 (1.8)	5, 982 (2.9)	4, 698 (1.2)	< .001
Pain interfering with work, n (%)				
Not at all	220, 845 (36.0)	53, 739 (25.9)	167, 106 (41.2)	
A little bit	187, 908 (30.6)	59, 924 (28.9)	127, 984 (31.5)	
Moderately	103, 434 (16.9)	42, 539 (20.5)	60, 895 (15.0)	
Quite a bit	78, 064 (12.7)	38, 244 (18.4)	39, 820 (9.8)	
Extremely	22, 971 (3.8)	12, 944 (6.2)	10, 027 (2.5)	< .001
Calm and peaceful, n (%)				
All of the time	106, 498 (17.3)	28, 207 (13.6)	78, 291 (19.3)	
Most of the time	304, 599 (49.6)	94, 250 (45.3)	210, 349 (51.7)	
A good bit of the time	85, 994 (14.0)	32, 572 (15.7)	53, 422 (13.1)	
Some of the time	76, 993 (12.5)	33, 981 (16.3)	43, 012 (10.6)	
A little of the time	30, 720 (5.0)	14, 817 (7.1)	15, 903 (3.9)	
None of the time	9, 700 (1.6)	4, 162 (2.0)	5, 538 (1.4)	< .001
Lots of energy, n (%)				
All of the time	46, 155 (7.5)	8, 045 (3.9)	38, 110 (9.4)	
Most of the time	213, 220 (34.8)	51, 429 (24.8)	161, 791 (39.9)	
A good bit of the time	114, 683 (18.7)	37, 197 (17.9)	77, 486 (19.1)	
Some of the time	127, 887 (20.8)	52, 771 (25.4)	75, 116 (18.5)	
A little of the time	75, 052 (12.2)	37, 681 (18.2)	37, 371 (9.2)	
None of the time	36, 332 (5.9)	20, 409 (9.8)	15, 923 (3.9)	< .001
Downhearted and blue, n (%)				
All of the time	12, 669 (2.1)	8, 295 (2.0)	4, 374 (2.1)	
Most of the time	14, 891 (2.4)	8, 159 (2.0)	6, 732 (3.3)	
A good bit of the time	22, 539 (3.7)	12, 597 (3.1)	9, 942 (4.8)	
Some of the time	93, 528 (15.3)	55, 035 (13.6)	38, 493 (18.6)	
A little of the time	176, 039 (28.8)	114, 522 (28.3)	61, 517 (29.7)	
None of the time	292, 074 (47.7)	206, 038 (50.9)	86, 036 (41.5)	< .001
Amount of time health interfering with social activities, n (%)				
All of the time	16, 238 (2.6)	8, 671 (4.2)	7, 567 (1.9)	
Most of the time	35, 503 (5.8)	18, 434 (8.9)	17, 069 (4.2)	
Some of the time	86, 773 (14.1)	38, 874 (18.7)	47, 899 (11.8)	
A little of the time	96, 954 (15.8)	37, 405 (18.0)	59, 549 (14.6)	
None of the time	379, 669 (61.7)	104, 770 (50.3)	274, 899 (67.5)	< .001

Physical health compared to one year ago, n (%)				
Much better	41, 767 (6.8)	13, 228 (6.3)	28, 539 (7.0)	
Slightly better	52, 250 (8.5)	18, 619 (8.9)	33, 631 (8.3)	
About the same	372, 896 (60.6)	106, 039 (50.9)	266, 857 (65.5)	
Slightly worse	120, 052 (19.5)	54, 004 (25.9)	66, 048 (16.2)	
Much Worse	28, 647 (4.7)	16, 447 (7.9)	12, 200 (3.0)	< .001
Emotional health compared to one year ago, n (%)				
Much better	57, 789 (9.5)	18, 117 (8.8)	39, 672 (9.9)	
Slightly better	50, 474 (8.3)	17, 432 (8.5)	33, 042 (8.2)	
About the same	431, 525 (71.0)	139, 064 (67.5)	292, 461 (72.7)	
Slightly worse	55, 717 (9.2)	24, 768 (12.0)	30, 949 (7.7)	
Much Worse	12, 660 (2.1)	6, 770 (3.3)	5, 890 (1.5)	< .001

Abbreviations: *CVD* cardiovascular disease; *VR-12* Veteran's RAND 12-item survey

[1] This category includes respondents who answered *yes* to having angina pectoris or coronary artery disease, congestive heart failure, myocardial infarction or heart attack, or other heart conditions (e.g., problems with heart valves or the rhythm of their heartbeat), or stroke.

[2] *P*-values reported compare those who reported not having been diagnosed with any CVD to those with CVD.

CHAPTER 4. THIRD MANUSCRIPT

Neighborhood Socioeconomic Disadvantage and Cardiovascular Disease Among Asian American, Native Hawaiian and Pacific Islander Older Adults

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ABSTRACT

Background: Research has demonstrated the association between socioeconomically deprived neighborhoods and higher mortality and incidence of cardiovascular disease (CVD). However, research on neighborhood socioeconomic factors has been less studied in the growing immigrant and aging Asian American and Native Hawaiian and Pacific Islander (NHPI) population. Guided by the ecosocial theory and theory of health services utilization, this study investigated the relationship between neighborhood disadvantage and CVD (any CVD, coronary artery disease, congestive heart failure, myocardial infarction, and stroke) in Asian American and NHPI older adults.

Methods: Data came from the 2011-2015 Medicare Health Outcomes Survey (HOS), a national survey administered by the Centers for Medicare and Medicaid Services, and the Neighborhood Atlas 2015 US Area Deprivation Index (ADI). The analytic sample included 29,918 respondents aged 65 and older who identified as Asian American or NHPI. Respondent 9-digit zip codes from the HOS were linked to the ADI. The ADI is a composite score generated from 17 Census measures of socioeconomic status and provides a ranking of neighborhood socioeconomic disadvantage relative to the nation. The 1st percentile represents the least disadvantaged and the 100th percentile represent the most disadvantaged neighborhood. Neighborhoods were defined as more disadvantaged (ADI above the 85th percentile) and less disadvantaged (ADI below the 85th percentile). Multivariate

logistic regression models were fit to explore the relationship between neighborhood disadvantage and CVD conditions.

Results: Overall, about 8% of respondents lived in more disadvantaged neighborhoods. Respondents living in more disadvantaged neighborhoods reported higher rates of diabetes, hypertension, smoking, and obesity. The percent of residence in more disadvantaged neighborhoods ranged from 2% among Japanese to 22% in Other Pacific Islander adults. Adults residing in more disadvantaged neighborhoods had greater odds of any CVD diagnosis (OR= 1.26, 95% CI: 1.14, 1.38), CAD (OR= 1.23, 95% CI: 1.08, 1.41), CHF (OR= 1.48, 95% CI: 1.26, 1.73), other heart conditions (OR= 1.21, 95% CI: 1.08, 1.35), and stroke (OR= 1.32, 95% CI: 1.13, 1.53) compared to adults in less disadvantaged neighborhoods; no difference was observed for MI (OR = 1.15, 95% CI: 0.97, 1.36). However, these association were not statistically significant after adjustment for predisposing characteristics, enabling resources and need factors.

Conclusion: Residence in more disadvantaged neighborhoods did not impact diagnoses of CVD conditions for Asian American and NHPI older adults. Future research should investigate how other neighborhoods measures such as ethnic enclaves or built environment characteristics protect or impede CVD health.

Introduction

Asian American adults aged 65 and older are the fastest growing older adult population in the US and globally (7,8). In 2018, 13% of Asian American and 9% of Native Hawaiians and Other Pacific Islander (NHPI) racial groups in the US were 65 years and older (109). Asian Americans are projected to make up the largest percentage (38%) of the immigrant population by 2065 (110). More than 65% of Asian Americans and 24% of NHPIs living in the US are foreign-born, and more than half of the foreign-born population are recent immigrants to the US (109), with an average residence of 10 to 15 years (111). The need for data disaggregation of Asian American and NHPI groups has been recognized but the data are still limited to understand and address the health issues of this growing population (112).

The trends in standardized mortality rate for heart disease did not decrease between 2003 and 2010 among Asian American adults and actually increased for Asian Indian adults, whereas the mortality rate declined every year for white adults (3). All Asian American ethnic groups also experienced higher proportionate mortality (i.e., CVD accounts for a larger percent of deaths in Asian American ethnic groups than white adults) from hypertensive disease and hemorrhagic stroke compared to white adults (3). However, there are considerable differences in the prevalence of CVD risk factors (48,113), CVD mortality (3,4) and health service access (26) by ethnicity. For example, the prevalence of diabetes ranged from 5% in Vietnamese to 14% in other Asian adults; and age-adjusted mean BMI varied between 22.9 kg/m^2 in Vietnamese to 25.1 kg/m^2 in Other Asian adults in Los Angeles County (114). The Ni-Hon-San study previously reported differences in

CVD risk factors such as blood pressure and cholesterol based on geographic location, such that rates were highest among Japanese men living in California than Japanese men living in Japan (115). This same study reported that the mortality rate of coronary heart disease (CHD) among Japanese men in Hawaii and California were two and three-fold higher, respectively, than Japanese men living in Japan (116). Other studies found lower prevalence of stroke among Japanese and Chinese adults with decreased length of residence in US (20). Some explanations for disparities in CVD include the impacts of socioeconomic status, immigration and acculturation (i.e., multidimensional process relating to the change that takes place when culturally different groups meet) on health behaviors and access to health care (35,111,117). The literature also supports the relationship and possible mediating role of health behaviors and neighborhoods on CVD risk (62,118).

Neighborhood factors like population socioeconomic status (119), built environment characteristics (120), social cohesion (121), and environmental hazards (122) may contribute to the racial/ethnic differences in CVD rates and risk factors. For example, living in neighborhoods with higher concentrations of Asians has been associated with smoking less among Asian women (123) and better dietary behaviors among Chinese Americans (121). However, the literature on the impact of neighborhood social environments on CVD health among Asian American adults is mixed (120,121,124–126) and the research on the impacts of neighborhoods on NHPI populations is even more sparse. Morey (2016) reported that NHPI neighborhoods were more likely to live near environmental hazards including toxic waste, industrial air pollution, and freeways compared to white and other racial/ethnic groups (122).

Thus, neighborhoods may be particularly important in understanding health disparities in NHPI populations. Few studies have examined the relationship of neighborhoods and health among disaggregated Asian American and NHPI ethnic groups and older adult populations (127,128). Furthermore, the majority of research in NHPI groups combine the NHPI and Asian American racial categories together (122), masking the unique histories of NHPI populations.

The area deprivation index (ADI) is a measure of neighborhood socioeconomic disadvantage that has been used to monitor trends in health inequalities. The ADI is calculated from indicators representing socioeconomic status, including median family income, income disparity, and family poverty rate (129). The Neighborhood Atlas, an online tool that provides ADI scores, was recently released with updated information to reflect the 2011-2015 five-year estimates from the US Census American Community Survey (ACS) (130). The Neighborhood Atlas allows zip codes to be linked to an ADI score that represents the neighborhood risk of socioeconomic disadvantage. Kind et al. (2015) found that patients living in more disadvantaged neighborhoods were at greater risk of rehospitalization than less disadvantaged neighborhoods, and that this risk of hospitalization was similar to chronic pulmonary disease (131). The effects of neighborhood are dynamic and can have a cumulative influence on health over the life course (62). Specific to older adults, Robert and Li (2001) reported that the impact of neighborhood socioeconomic status is more important for health among older adults compared to young adults, and that neighborhood socioeconomic status had a stronger effect on health compared to individual socioeconomic status (132). Understanding neighborhood socioeconomic

disadvantage within and among Asian American and NHPI groups may provide key information on the mechanism of how neighborhood environments promote or worsen overall health (133).

We integrated Krieger's ecosocial theory and Andersen and Newman's theory of health services utilization to guide our research on the multilevel factors impacting health and access to health care resources (27,28). This ecosocial theory emphasizes that patterns of disease are influenced by biological and psychosocial factors at multiple levels of society (e.g., individual, household, national) and the role of historical context over the life course (27), which influences the individual- and environmental-factors associated with health care utilization and access to health care services. The main tenets of Andersen and Newman's theory are that predisposing characteristics such as age, enabling resources such as income, and need characteristics such as CVD risk factors and neighborhood environments collectively influence health care use. We expect that disparities in CVD risk among Asian American and NHPI older adults are partially attributable to the interplay of individual immigration and acculturation experiences and neighborhood socioeconomic deprivation. Asian American and NHPIs have different immigration and settlement patterns into the US, which influences where individuals decide to settle and their neighborhood characteristics (11,33). Thus, neighborhood characteristics (e.g., neighborhood socioeconomic status) are related to race/ethnicity and socioeconomic position (34). These neighborhood characteristics could influence the availability to language-concordant or culturally-relevant health care services. Individual-level factors related to acculturation and immigration could impact health-

related behaviors and dietary habits (35) that are enabled or impeded by their neighborhood environments (36).

In this study, we investigated the relationship between neighborhood socioeconomic disadvantage on self-reported CVD conditions and stroke among a nationally-representative sample of Asian American (Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian, Multiple-race Asian) and NHPI (Native Hawaiian and Other Pacific Islander) older adults enrolled in Medicare Advantage health plans.

Methods

Participants

Our individual-level data were obtained from five cohorts of the baseline Medicare HOS (2011–2015), a patient-reported outcomes survey administered to Medicare Advantage members by the Centers for Medicare and Medicaid Services (CMS). The HOS collect information on individual health status for monitoring and quality improvement efforts of Medicare Advantage programs. The HOS randomly samples Medicare Advantage organizations that have a minimum of 500 members. Baseline surveys in English, Spanish, and Chinese are mailed to members and telephone calls are conducted in English and Spanish for nonresponses and incomplete surveys. We excluded respondents who were younger than 65 years old, did not self-identify as Asian American or NHPI, in hospice or institutionalized, and had end-stage renal disease. We excluded survey respondents whose residential zip code could not be linked (n=316) and zip codes that were listed as P (zip code is a

post office box and does not represent a neighborhood) (n=119) and were not associated with an ADI score. Characteristics of the survey respondents have been described in greater detail elsewhere (cite aim 1). The final analytical sample included 29,918 respondents.

Dependent Variables

Respondents were asked whether a doctor had diagnosed them with coronary artery disease, congestive heart failure, myocardial infarction, other heart conditions such as problems with heart valves or the rhythm of their heartbeat, and stroke. The primary outcomes were prevalence of combined (any diagnosis of CVD conditions) and individual types of CVD conditions.

Primary Independent Variables

Based on the ecosocial theory, we conceptualized self-reported race/ethnicity as a social construct representing the diverse immigration and acculturation experiences of Asian American and NHPI ethnic groups (11,33,35). Each disaggregated racial/ethnic group represents a unique social context. We hypothesize that these individual experiences are related to structural characteristics of neighborhoods that impact health status and health outcomes over the life course (118,134).

We categorized self-reported race/ethnicity into 10 Asian American and NHPI categories: non-Hispanic Asian Indian, non-Hispanic Chinese, non-Hispanic Filipino, non-Hispanic Japanese, non-Hispanic Korean, non-Hispanic Vietnamese, non-Hispanic Other Asian, Multiple-race Asian, non-Hispanic Native Hawaiian, and non-Hispanic Other Pacific Islander. The multiple-race Asian group included respondents

who identified as an Asian American ethnic group and another race or Hispanic ethnicity. The Native Hawaiian group included respondents who identified as Native Hawaiian and any racial/ethnic group. The Other Pacific Islander group included respondents who identified as Guamanian or Chamorro, Samoan, and other Pacific Islander. Chinese respondents were the referent group for analyses because they make up the largest Asian American ethnic group in the US (109) and are likely to have lived in the US for longer compared to other Asian American ethnic groups (135,136). We also choose Chinese respondents as the reference group because of the overall larger sample size compared to other groups, and adequate sample residing in more disadvantaged neighborhoods.

Neighborhood-level Measure

Survey respondents had 9-digit residential zip codes collected in the HOS, which were used to link to neighborhood-level data. Neighborhoods are constructed based on Census block groups. We operationalized the 2015 US Area Deprivation Index (ADI) from the Neighborhood Atlas to measure neighborhood socioeconomic disadvantage (137). The ADI is a composite index calculated from 17 measures from the 2011–2015 ACS five-year estimates conducted by the US Census Bureau (Table 4.3). This index covers four domains including poverty, housing, employment, and education. The 2015 ADI file contains an ADI score percentile from 1 to 100 for each Census block group (neighborhood) that is based on the ranking of neighborhood relative to the nation. The 1st percentile represents the least disadvantaged and the 100th percentile represent the most disadvantaged neighborhood.

Prior research has reported that 30-day rehospitalization rates increased as ADI score increases (i.e., more disadvantaged neighborhood) and that living in the most disadvantaged 15% of neighborhoods was significantly associated with an increased risk of rehospitalization among Medicare patients (131). Therefore, to be consistent with prior constructions of neighborhood disadvantage (131,138), we categorized the ADI score percentile into two neighborhood types: less disadvantaged neighborhoods (ADI scores ≤ 85th percentile) and more disadvantaged neighborhoods (ADI scores > 85th percentile).

Individual-level and Health Plan Covariates

Based on the ecosocial theory and the theory of health services utilization, we selected individual-level and Medicare Advantage plan covariates. Individual-level covariates included predisposing, enabling and need factors that could be potential confounders or mediators of the association between of the neighborhood characteristics and CVD risk (34,139). Predisposing factors included age, sex, marital status, and educational attainment. Enabling factors included income and Medicare/Medicaid status. Individual-level need factors included self-reported diagnoses of diabetes and hypertension, body mass index (BMI) and smoking status. Medicare Advantage plan covariates included factors that could influence access to and quality of health care services, such as if a proxy had completed the survey, plan's regional office location and survey year.

Statistical Analysis

We examined respondent sociodemographic characteristics, CVD risk factors, and CVD prevalence according to the ADI neighborhood type. We then examined

distributions of ADI neighborhood type by race/ethnicity. We compared distributions using chi-square and one-way ANOVA tests. We fit three logistic regression models for the combined CVD conditions and each individual CVD condition. The first model examined the effects of neighborhood type and race/ethnicity on CVD conditions. The second model included all individual-level and health plan covariates. Chinese adults were the referent group for all analyses. The third model included the interaction term (neighborhood type * race/ethnicity) to test whether race/ethnicity moderated the relationship between neighborhood type and CVD (Supplemental table 4). In other words, compared to Chinese adults living in more disadvantaged neighborhoods, does living in more disadvantaged neighborhoods for other Asian and NHPI ethnic groups increase or decrease their risk of CVD. In the third model, some data cells for the interaction terms were suppressed due to the small cell sizes. All analyses were conducted with RStudio, version 1.1.453 (55).

Results

The analytic sample included 29,918 respondents (Table 4.1). Overall, about 8% of respondents lived in more disadvantaged neighborhoods. All characteristics were statistically different among neighborhood types except for sex. Respondents living in more disadvantaged neighborhoods were older, had less education and household income, were not married, and had Medicaid. Adults in more disadvantaged neighborhoods reported higher rates of diabetes, hypertension, smoking, and obesity than adults in the less disadvantaged neighborhoods. Respondents living in more disadvantaged neighborhoods were more likely to have a

proxy complete the HOS survey. The majority of individuals in more disadvantaged neighborhoods were in the San Francisco and New York region, which was reflective to the regional distribution of respondents in the sample.

Figure 4.1 shows the distribution of neighborhood types by the total sample and race/ethnicity. The neighborhood types were statistically different across racial/ethnic groups. The percent of residence in more disadvantaged neighborhoods ranged from 2% among Japanese to 22% in Other Pacific Islander adults. Other Pacific Islander respondents lived in more disadvantaged neighborhoods three times more often than Asians overall and four times more often than Native Hawaiian adults.

Figure 4.2 shows the prevalence of combined and individual CVD conditions for the total sample by neighborhood type. The comparisons between neighborhood types and CVD conditions were statistically different. Overall, 9% of adults who reported any CVD conditions lived in more disadvantaged neighborhoods compared to 7% of adults who reported no CVD conditions. When we compared neighborhood types by CVD conditions, we observed a little more difference. For example, 12% of adults who reported CHF lived in more disadvantaged neighborhoods compared to 7% of adults who reported no CHF. More women (Figure 4.3) reported living in more disadvantaged neighborhoods than men (Figure 4.4), for combined and all individual types of CVD conditions.

Table 4.2 (Model 1) shows that the relationship of CVD conditions and neighborhood type after adjusting for race/ethnicity. Adults residing in more disadvantaged neighborhoods had greater odds of any CVD diagnosis (OR= 1.26,

95% CI: 1.14, 1.38), CAD (OR= 1.23, 95% CI: 1.08, 1.41), CHF (OR= 1.48, 95% CI: 1.26, 1.73), other heart conditions (OR= 1.21, 95% CI: 1.08, 1.35), and stroke (OR= 1.32, 95% CI: 1.13, 1.53) compared to adults in less disadvantaged neighborhoods; no difference was observed for MI (OR = 1.15, 95% CI: 0.97, 1.36). Even after adjustment for neighborhood, some Asian American ethnic groups had significantly higher CVD conditions than Chinese. Asian Indian, Multiple race Asian, Native Hawaiian and Other Pacific Islander adults consistently had significantly greater odds of reporting most CVD conditions than Chinese adults. There were mixed trends and significance with other Asian American ethnic groups. Korean adults had lower odds of any CVD, CAD, and other heart conditions; Filipino adults had greater odds of CHF and stroke but lower odds of CAD; and Japanese adults had higher odds of any CVD, CHF, MI and stroke compared to Chinese adults.

In the fully adjusted analyses (Table 4.2, Model 2), the positive association between CVD conditions and living more disadvantaged neighborhoods was no longer statistically significant. We observed similar trends in CVD conditions across Asian American and NHPI populations. We tested the moderating effect of race/ethnicity on the relationship between neighborhood type and CVD using interactions (Table 4.2). Most interactions of race/ethnicity by disadvantaged neighborhoods were not statistically significantly related to CVD outcomes. In some cases, data cells were suppressed because of the small cell sizes. The only significant interaction was for Filipino adults which suggests that for Filipino adults, living in more disadvantaged neighborhoods increased their odds of having CVD compared with Chinese adults in more disadvantaged neighborhoods.

Discussion

We examined the association of neighborhood disadvantage with self-reported CVD conditions and stroke among Asian American and NHPI older adults enrolled in Medicare Advantage health plans, where we assessed to what extent neighborhood socioeconomic environments protected or impeded CVD health. We found little evidence to support the hypothesis that residing in more disadvantaged neighborhoods is associated with increased risk of self-reported CVD conditions and stroke after accounting for predisposing characteristics, enabling resources and need factors. However, we found that Filipino adults living in more disadvantaged neighborhoods had an increased risk of reporting any CVD conditions compared to Chinese adults living in more disadvantaged neighborhoods.

Contrary to prior studies examining neighborhood socioeconomic status on health (138,140–142), we did not find a significant association between greater neighborhood socioeconomic disadvantage and CVD risk among Asian American and NHPI older adults. Prior studies over the past two decades have found that socioeconomically disadvantaged neighborhoods were associated with CVD risk factors (140), greater incidence of CVD outcomes (141), and greater mortality (142). For example, the Dallas Heart Study found that living in neighborhoods with high socioeconomic deprivation was associated with greater obesity and that living in these deprived neighborhoods for longer periods resulted in worse outcomes (more weight gain) (140). The differences in these findings might be explained by the measurement of neighborhood socioeconomic environment, like the use of

neighborhood education and income (142) versus an index score like the ADI. However, our findings are consistent with prior studies that have found that the association of neighborhood disadvantage are small or become null after adjusting for individual-level socioeconomic covariates (138,141). For instance, the prospective Atherosclerosis Risk in Communities Study found that residing in more disadvantaged neighborhoods was associated with a greater incidence of coronary heart disease (141), but this association was weakened after adjusting for individual-level socioeconomic status (141). Another explanation could be that the domains of ADI neighborhood disadvantage (poverty, housing, employment, education) have insignificant impacts on diagnosis of CVD conditions. Other measures of neighborhood environments might explain the link with CVD conditions, such as concentration of racial/ethnic groups in the area or the number of Medicare Advantage organizations within each neighborhood. We examined neighborhood disadvantage across the nation, and there may be unmeasured local neighborhood factors that are critical to how the pathway of neighborhood socioeconomic disadvantage affects health.

The literature on neighborhood social environments and CVD risk have found mixed associations in Asian American populations compared to other racial/ethnic groups. For example, Wong and colleagues (2019) found that social environments (social cohesion and safety) were not associated with reduced obesity among Asian Americans, while they were protective for white, Hispanic and African American groups (120). This study also reported that living in neighborhoods with higher percentages of Asian Americans was associated with lower prevalence of obesity

(120). This finding could be explained by the aggregate Asian American group, where we would hypothesize that social environments may be associated with better obesity outcomes if data were examined by specific ethnic groups. Previous research on the impact of concentration of racial/ethnic groups in neighborhoods (i.e., ethnic enclaves like Chinatowns) are also inconsistent. Enclaves have been found to be associated with better diet (121), lower obesity (120), and more positive general health perceptions (124) but not with physical activity (121), current smoking, hypertension or diabetes (124).

Research suggests that the patterning of neighborhoods for Asian American and NHPI groups are different than other racial/ethnic groups (143–145). Asian Americans are more likely to live in affluent suburban neighborhoods with greater concentrations of immigrant populations (146). The neighborhood racial/ethnic composition also varies by ethnic group (18), which may be reflective of the different settlement patterns of Asian American and NHPI populations. For example, the distribution of Asian American and NHPI populations across the US varies, with more Filipino, Japanese and Korean individuals residing in Los Angeles while more Chinese and Indian individuals in New York (145). The concentrations of racial/ethnic groups across neighborhoods may also vary (18). Thus, there may be unmeasured neighborhood characteristics that may be important for understanding CVD risk among Asian American and NHPI populations.

Our results should be interpreted with caution. First, the cross-sectional study design of the HOS limits the ability to infer causation between neighborhood type and CVD conditions. Second, the ADI scores from the Neighborhood Atlas are calculated

at the census block level to define neighborhoods, which may not correspond with how survey respondents define their neighborhood area. We attempted to test alternative ADI thresholds for neighborhood disadvantage, however we were unable to test our hypotheses when the cells were further disaggregated by race/ethnicity and CVD condition. However, the Neighborhood Atlas data are being used to inform the delivery of other CMS programming like Everyone with Diabetes Counts (147), a diabetes self-management education program. The ADI is a composite variable and we did not test the relationships of CVD risk with each of the ADI domains (i.e., poverty, housing, employment and education). Third, we conceptualized self-reported race/ethnicity as a proxy for the pathways of immigration and acculturation that might explain our findings. However, this variable does not fully capture the unique profiles of each Asian American and NHPI ethnic group. Fourth, the HOS interview follow-up for incomplete or nonresponse surveys are conducted in either English or Spanish. The Chinese language option was only offered for the mail surveys. Thus, we expect that our sample may be more fluent in English which may potentially underestimate the number of respondents living in more disadvantaged neighborhoods and who have diagnosed CVD. Lastly, the HOS provides self-report of CVD diagnoses and these data are susceptible to recall and measurement biases.

Notwithstanding these limitations, our study extends results from prior research on neighborhood environments and CVD risk (120,124–126). The current analysis of the HOS allowed us to disaggregate data by 10 racial/ethnic groups with a considerable number of respondents with CVD conditions. Residence in more disadvantaged neighborhoods did not impact diagnoses of CVD conditions for Asian

American and NHPI older adults. Our study also provides a baseline picture of the geographic regions and neighborhood types where Asian American and NHPI older adults reside. This evidence can inform regions that require more resources to improve current neighborhood socioeconomic conditions and underexplored regions that may warrant more investigation.

Given the variation in histories and patterning of neighborhoods among Asian American and NHPI populations, future studies are warranted to understand the role of neighborhood environments. CVD is largely preventable and understanding the patient experiences and identifying high-risk individuals could prevent adverse events like rehospitalizations (131). For example, Asian American and NHPI (combined) Medicare Advantage beneficiaries reported worse experiences than white beneficiaries for 7 out of 8 patient experience measures including getting needed care, doctors who communicated well, care coordination, getting needed prescription drugs, and getting information about prescription drugs (148). Using these patient experience measures in conjunction with the Neighborhood Atlas to identify the most disadvantaged neighborhoods could inform where and what resources and services should be allocated. For example, the availability of translated health care interventions to prevent CVD risk factors, could be particularly important for high-risk populations with limited English proficiency. Future research should investigate how neighborhoods (e.g., social capital, ethnic enclave or built environment) vary over time, and the cumulative impact of neighborhoods advantages and disadvantages in health over the life course (149). Furthermore, integrating subjective and objective data into future work may improve our understanding of neighborhood-level

mechanisms that impede, maintain or improve health among older adults, particularly among high-risk racial/ethnic minority adults (149).

Table 4.1. Respondents Characteristics of Asian American and NHPI adults by Neighborhood Type, Medicare Health Outcomes Survey, 2011-2015 (N = 29,918)

		Neighborhood Type [a]		
	Total sample	Less Disadvantaged	More Disadvantaged	*p*-value [b]
Characteristic	N= 29,918	N= 27,655	N= 2,263	
Predisposing Characteristics				
Average age in years (SD)	74.0 (6.8)	74.0 (6.8)	74.4 (7.0)	<.05
Age group, years				
65 - 69	31.9	32.0	30.1	
70 - 74	27.9	28.0	26.8	
75 - 79	19.1	18.9	20.2	
80 - 84	12.3	12.3	13.1	
≥ 85	8.8	8.7	9.8	<.01
Sex				
Male	45.2	45.2	44.7	
Female	54.8	54.8	55.3	.68
Race/Ethnicity				
Asian Indian	8.7	8.8	6.4	
Chinese	19.9	19.9	20.0	
Filipino	17.9	18.4	12.1	
Japanese	11.7	12.3	3.3	
Korean	5.4	5.4	5.3	
Vietnamese	6.4	6.3	8.2	
Other Asian	4.4	4.4	5.0	
Multiple Race Asian	10.6	10.4	12.4	
Native Hawaiian	7.2	7.4	5.0	
Other Pacific Islander	7.8	6.6	22.2	<.001
Education				
Less than high school	29.7	28.1	49.4	
High school graduate or GED	23.0	23.1	21.8	
Some college or two-year degree	17.7	18.1	12.1	
Four-year college degree or more	29.6	30.7	16.7	<.001
Marital status				
Married	59.9	61.1	46.3	
Divorced	13.0	12.3	20.5	
Widowed	22.4	22.0	26.2	
Never Married	4.7	4.6	6.9	<.001
Enabling Factors				

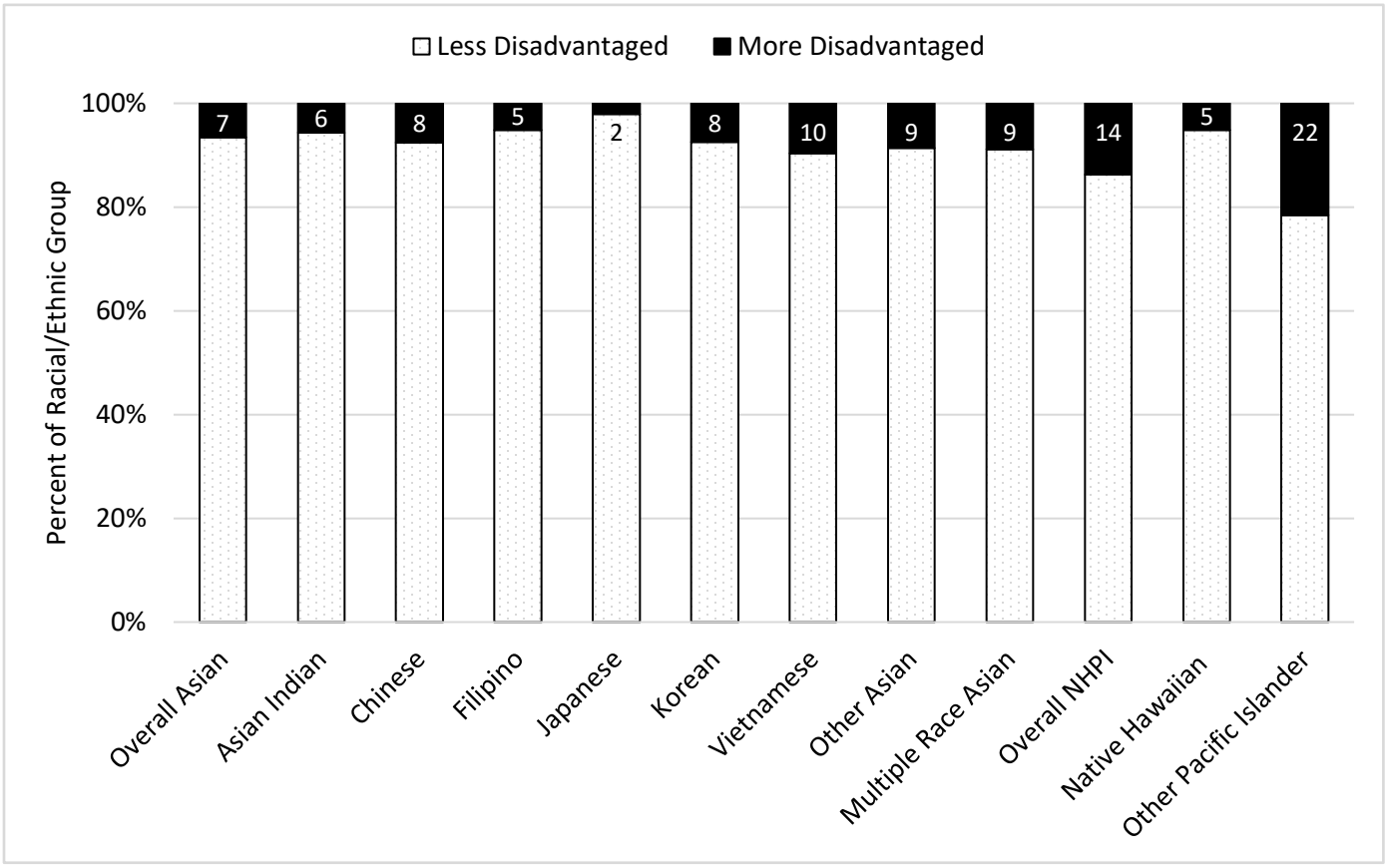
Household income				
< $10,000	21.0	19.5	39.6	
$10,000 – 19,999	20.2	19.4	30.2	
$20,000-29,999	11.1	11.3	8.0	
$30,000-49,999	14.8	15.5	6.1	
> $50,000	17.4	18.6	3.4	
Not reported	15.5	15.7	12.8	<.001
Medicaid				
No	59.9	62.4	30.0	
Yes	40.1	37.6	70.0	<.001
Individual Need Factors				
Diabetes				
No	66.6	66.9	62.7	
Yes	33.4	33.1	37.3	<.001
Hypertension				
No	32.8	33.0	29.5	
Yes	67.2	67.0	70.5	<.001
Smoking Status				
No	92.5	92.8	89.0	
Smokes everyday	4.0	3.8	5.7	
Smokes somedays	2.4	2.3	3.1	
Don't know	1.2	1.1	2.3	<.001
BMI category [c]				
Normal	33.9	34.0	32.6	
Underweight	4.2	4.2	4.3	
Overweight	41.8	42.0	39.0	
Obese	20.1	19.7	24.1	<.001
Contextual Need Factors				
Person who completed survey, %				
Person addressed	74.6	75.6	62.4	
Family member	22.1	21.6	27.5	
Friend or caregiver	3.3	2.8	10.1	<.001
Plan's CMS Regional Office [d]				
Boston	1.6	1.5	2.2	
New York	9.7	8.7	21.7	
Philadelphia	4.2	4.3	3.2	
Atlanta	7.3	7.0	10.2	
Chicago	6.9	6.7	9.2	
Dallas	5.7	5.6	6.8	
Kansas City	1.8	1.9	1.2	
Denver	1.5	1.6	0.6	
San Francisco	56.0	57.0	43.1	
Seattle	5.3	5.6	1.8	<.001

Abbreviations: *BMI* body mass index; *NHPI* Native Hawaiian and other Pacific Islander
Note: Column percentages are calculated and may not total 100% due to rounding.

[a] Less disadvantaged neighborhoods were areas with an ADI score ≤85th percentile. More disadvantaged neighborhoods were areas with an ADI score >85th percentile.
[b] We tested for differences across neighborhood type using one-way analysis of variance for continuous variables and chi-square tests for categorical variables.
[c] Asian-specific thresholds (overweight = 23 – 27.5 kg/m^2, obese ≥ 27.5 kg/m^2) were applied for Asian American ethnic groups.

[d] The CMS regional offices are the state and local representation for Medicare Advantage plans. Each region represents several states.

Figure 4. 1. Percent Distribution of Neighborhood Type among Asian American and NHPI adults by Race/Ethnicity, Medicare Health Outcomes Survey, 2011-2015

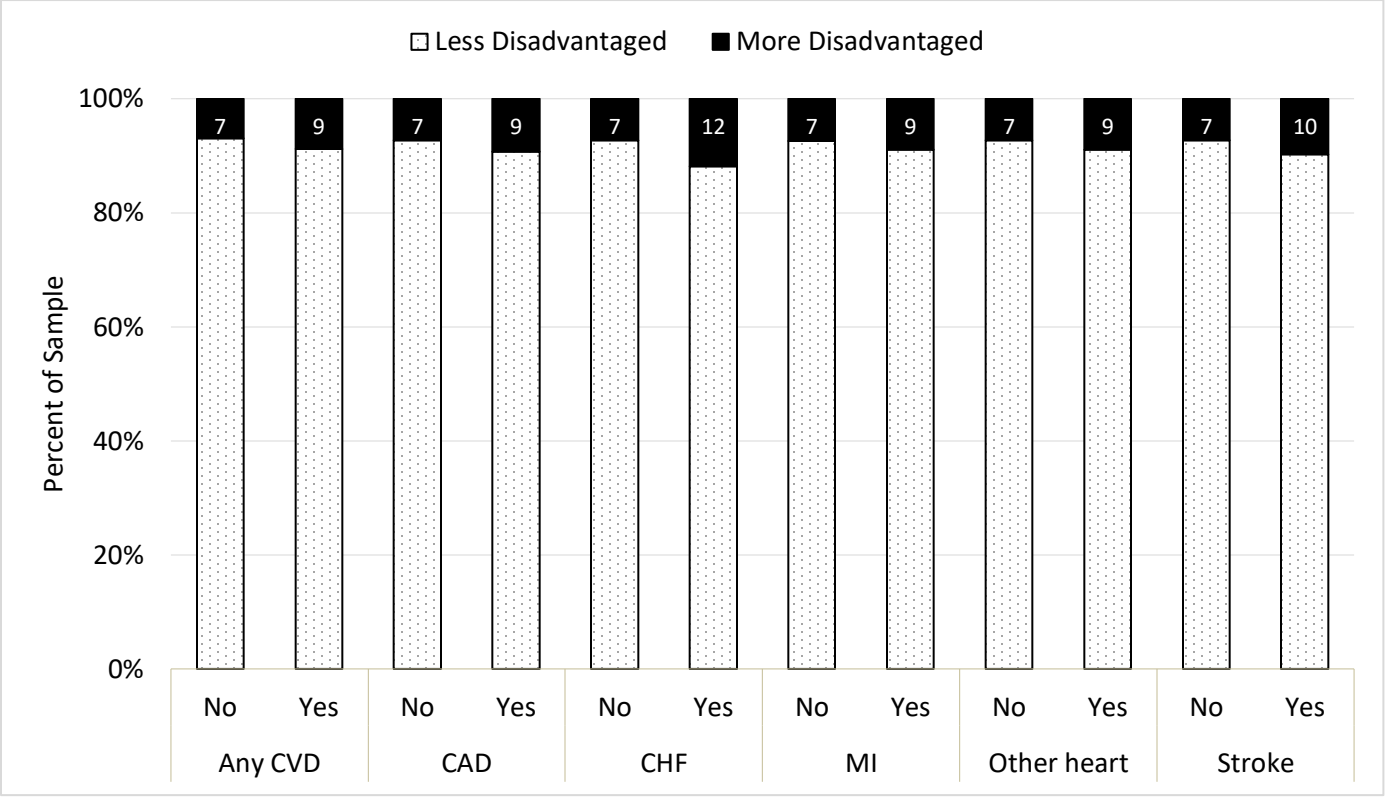


Abbreviations: *NHPI* Native Hawaiian and other Pacific Islander

Note: Less disadvantaged neighborhoods were areas with an ADI score ≤85th percentile. More disadvantaged neighborhoods were areas with an ADI score >85th percentile. Interpretation: among the overall Asian group, 7% lived in more disadvantaged neighborhoods. Chi-square comparison between neighborhood types and racial/ethnic groups were significant at a $p < 0.05$ level.

ASIAN Total sample is

Figure 4. 2. Percent Distribution of Neighborhood Type by CVD Conditions and Stroke among Asian American and NHPI adults, Medicare Health Outcomes Survey, 2011-2015



Abbreviations: *CAD* coronary artery disease; *CHF* congestive heart failure; *CVD* cardiovascular disease; *MI* myocardial infarction

Note: Less disadvantaged neighborhoods were areas with an ADI score ≤85th percentile. More disadvantaged neighborhoods were areas with an ADI score >85th percentile. Interpretation: among those who did not have any CVD, 7% lived in more disadvantaged neighborhoods. Chi-square comparison between neighborhood types and CVD conditions were significant at a $p < 0.05$ level.

Table 4.2. Adjusted Odds Ratios and 95% CI of CVD conditions and stroke by Neighborhood Type and Race/Ethnicity among Asian American and NHPI adults, 2011–2015

	Any CVD				CAD				CHF			
	Model 1 [a]		Model 2 [b]		Model 1 [a]		Model 2 [b]		Model 1 [a]		Model 2 [b]	
Characteristics	aOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)	
Neighborhood Type												
Less Disadvantage	1.00		1.00		1.00		1.00		1.00		1.00	
More Disadvantage	1.26 (1.14, 1.38)	***	1.03 (0.92, 1.16)		1.23 (1.08, 1.41)	**	1.03 (0.88, 1.21)		1.48 (1.26, 1.73)	***	1.15 (0.95, 1.38)	
Race/Ethnicity												
Chinese	1.00		1.00		1.00		1.00		1.00		1.00	
Asian Indian	1.19 (1.07, 1.32)	**	1.06 (0.94, 1.21)		1.76 (1.53, 2.03)	***	1.59 (1.35, 1.87)	***	1.62 (1.30, 2.02)	***	1.66 (1.29, 2.14)	***
Filipino	1.02 (0.94, 1.12)		0.92 (0.83, 1.01)		0.94 (0.82, 1.07)		0.86 (0.74, 0.99)	*	1.54 (1.29, 1.85)	****	1.44 (1.17, 1.77)	***
Japanese	1.05 (0.95, 1.16)		1.13 (1.01, 1.27)	*	0.76 (0.65, 0.89)	***	0.89 (0.74, 1.07)		1.05 (0.84, 1.31)		1.43 (1.10, 1.86)	**
Korean	0.65 (0.56, 0.75)	***	0.73 (0.62, 0.85)	***	0.66 (0.53, 0.83)	***	0.76 (0.60, 0.97)	*	1.00 (0.74, 1.34)		1.30 (0.93, 1.83)	
Vietnamese	0.93 (0.82, 1.05)		0.89 (0.77, 1.02)		0.83 (0.69, 1.01)		0.80 (0.65, 1.00)		1.71 (1.35, 2.17)	***	1.64 (1.26, 2.14)	***
Other Asian	0.99 (0.86, 1.14)		0.93 (0.79, 1.09)		1.08 (0.88, 1.32)		1.04 (0.82, 1.30)		1.82 (1.40, 2.36)	***	1.51 (1.11, 2.06)	**
Multiple race	1.37	***	1.43	***	1.37	***	1.45	***	2.48	***	2.76	***

Asian	(1.24, 1.52)		(1.28, 1.61)		(1.19,1.57)		(1.23, 1.70)		(2.05, 2.99)		(2.23, 3.43)	
Native Hawaiian	1.66 (1.49, 1.86)	***	1.85 (1.62, 2.12)	***	1.45 (1.24, 1.70)	***	1.73 (1.44, 2.08)	***	3.29 (2.71, 4.00)	***	3.96 (3.12, 5.02)	***
Other Pacific Islander	1.40 (1.25, 1.56)	***	1.36 (1.19, 1.56)	***	1.43 (1.23, 1.67)	***	1.45 (1.20, 1.74)	***	3.11 (2.57, 3.77)	***	2.67 (2.12, 3.37)	***
	MI				Other Heart				Stroke			
	Model 1 [a]		Model 2 [b]		Model 1 [a]		Model 2 [b]		Model 1 [a]		Model 2 [b]	
	AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)	
Neighborhood Type												
Less Disadvantage	1.00		1.00		1.00		1.00		1.00		1.00	
More Disadvantaged	1.15 (0.97, 1.36)		1.03 (0.85, 1.26)		1.21 (1.08, 1.35)	**	1.04 (0.91, 1.19)		1.32 (1.13, 1.53)	***	1.09 (0.91, 1.30)	
Race/Ethnicity												
Chinese	1.00		1.00		1.00		1.00		1.00		1.00	
Asian Indian	2.35 (1.95, 2.83)	***	2.06 (1.66, 2.56)	***	0.92 (0.80, 1.05)		0.86 (0.74, 1.00)	*	1.22 (1.01, 1.48)	*	1.20 (0.95, 1.50)	
Filipino	1.22 (1.02, 1.46)	*	1.12 (0.91, 1.37)		1.00 (0.90, 1.11)		0.91 (0.81, 1.02)		1.30 (1.12, 1.52)	***	1.19 (1.00, 1.42)	*
Japanese	1.34 (1.10, 1.64)	**	1.70 (1.35, 2.13)	***	1.00 (0.89, 1.12)		1.03 (0.90, 1.18)		1.29 (1.08, 1.53)	**	1.70 (1.39, 2.09)	***
Korean	0.80 (0.59, 1.08)		0.84 (0.60, 1.19)		0.61 (0.51, 0.73)	***	0.69 (0.57, 0.84)	***	0.85 (0.65, 1.10)		1.01 (0.76, 1.35)	
Vietnamese	1.16		1.07		0.86	*	0.85		1.37	**	1.20	

	(0.90, 1.48)		(0.81, 1.41)		(0.74, 1.00)		(0.72, 1.01)		(1.11, 1.68)		(0.95, 1.52)	
Other Asian	1.62 (1.25 2.09)	***	1.45 (1.08, 1.93)	*	0.91 (0.76, 1.07)		0.89 (0.73, 1.08)		1.16 (0.91, 1.49)		1.10 (0.83, 1.46)	
Multiple race Asian	2.00 (1.67, 2.41)	***	2.18 (1.77, 2.68)	***	1.24 (1.11, 1.39)	***	1.30 (1.14, 1.48)	***	1.75 (1.49, 2.07)	***	1.87 (1.54, 2.26)	***
Native Hawaiian	2.92 (2.42, 3.52)	***	3.58 (2.87, 4.48)	***	1.47 (1.30, 1.67)	***	1.48 (1.28, 1.73)	***	2.42 (2.04, 2.88)	***	3.02 (2.45, 3.72)	***
Other Pacific Islander	2.27 (1.87, 1.74)	***	2.15 (1.71, 2.71)	***	1.29 (1.14, 1.47)	***	1.19 (1.02, 1.39)	*	1.73 (1.44, 2.07)	***	1.56 (1.25, 1.94)	***

* $p < 0.05$; ** $p < 0.01$; ***$p < 0$ .001

Abbreviations: *AOR* adjusted odds ratio; *CAD* coronary artery disease; *CHF* congestive heart failure; *CI* confidence intervals; *CVD* cardiovascular disease; *MI* myocardial infarction

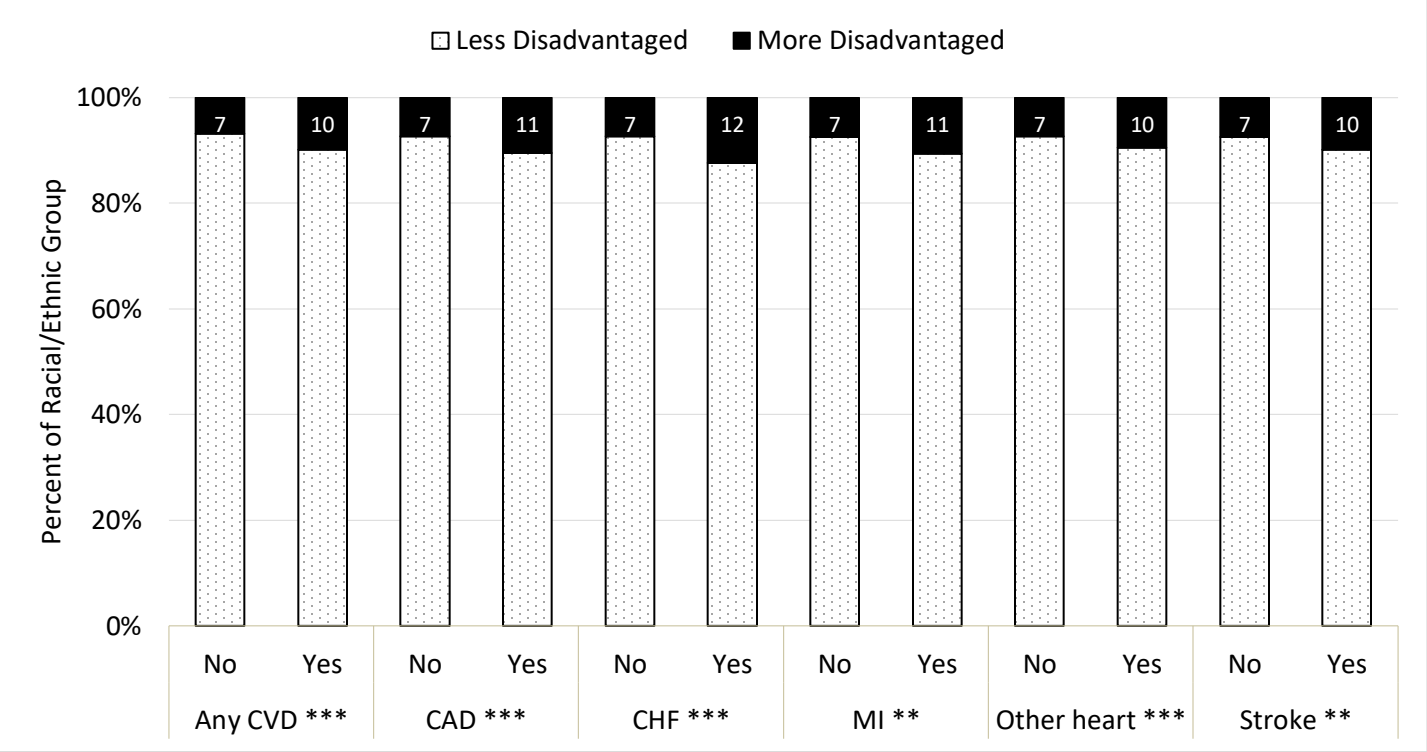
Dashes "–" are displayed for cells with less than 11 respondents following the CMS cell size suppression policy.

[a] Model 1: Covariates included race/ethnicity and neighborhood disadvantage.
[b] Model 2: Covariates included race/ethnicity, neighborhood disadvantage, age, sex, marital status, educational level, income, Medicare/Medicaid status, diabetes, hypertension, body mass index (BMI), smoking status, survey year, whether a proxy completed the survey, and plan regional office.

Table 4.3. Supplemental Table - 2013 US Area Deprivation Index Variables

Domains	**Categories**
Poverty	Median family income, $
	Income disparity
	Families below poverty level, %
	% population below 150% poverty threshold, %
	Single parent households with dependents <18, %
	Households without a motor vehicle, %
	Households without a telephone, %
	Occupied housing units without complete plumbing, %
Housing	Owner occupied housing units, %
	Households with >1 person per room, %
	Median monthly mortgage, $
	Median gross rent, $
	Median home value, $
Employment	Employed person 16+ in white collar occupation, %
	Civilian labor force unemployed (aged 16+), %
Education	Population aged 25+ with <9yr education, %
	Population aged 25+ with at least a high school education, %

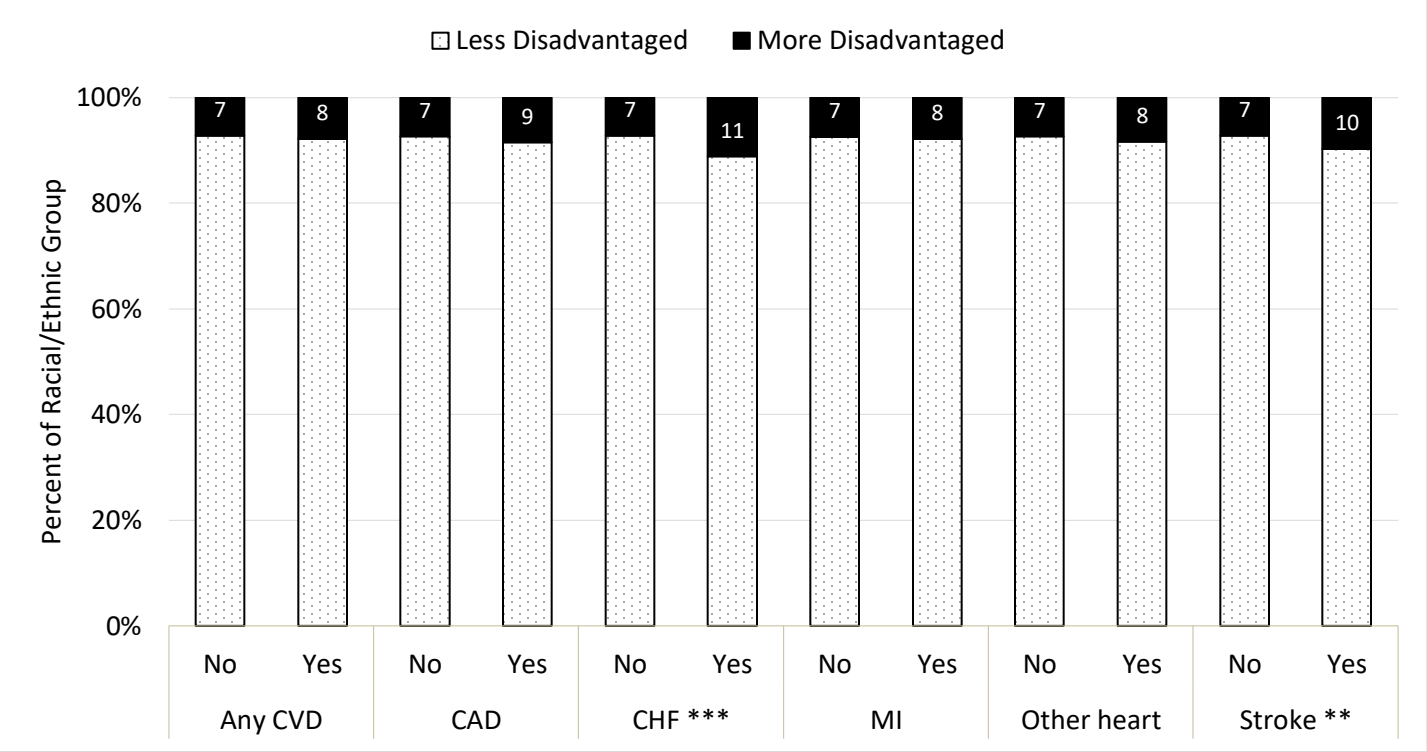
Figure 4. 3. Supplemental Table - Percent Distribution of Neighborhood Type by CVD Conditions and Stroke among Asian American and NHPI Women, Medicare Health Outcomes Survey, 2011-2015



** $p < 0.01$; ***$p < 0$ .001

Note: We performed chi-square tests to compare neighborhood types and each CVD condition.

Figure 4. 4. Supplemental Table - Percent Distribution of Neighborhood Type by CVD Conditions and Stroke among Asian American and NHPI Men, Medicare Health Outcomes Survey, 2011-2015



** $p < 0.01$; ***$p < 0$ .001

Note: We performed chi-square tests to compare neighborhood types and each CVD condition.

Table 4.4. Supplemental - Fully Adjusted Odds Ratios and 95% CI of CVD conditions and stroke by Neighborhood Type and Race/Ethnicity (with interaction term) among Asian American and NHPI adults, 2011–2015

Characteristics	Any CVD		CAD		CHF		MI		Other Heart		Stroke	
	AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)	
Neighborhood Type												
Less Disadvantage	1.00		1.00		1.00		1.00		1.00		1.00	
More Disadvantage	0.94 (0.72, 1.23)		1.09 (0.76, 1.57)		0.93 (0.54, 1.59)		1.11 (0.67, 1.83)		0.96 (0.71, 1.31)		1.42 (0.95, 2.12)	
Race/Ethnicity												
Chinese	1.00		1.00		1.00		1.00		1.00		1.00	
Asian Indian	1.03 (0.91, 1.18)		1.54 (1.30, 1.83)	***	1.58 (1.21, 2.06)	***	1.15 (0.93, 1.41)	***	0.84 (0.71, 0.98)	*	1.19 (0.94, 1.51)	
Filipino	0.91 (0.82, 1.01)		0.87 (0.75, 1.02)		1.43 (1.15, 1.78)	**	1.15 (0.93, 1.41)		0.90 (0.80, 1.02)		1.23 (1.03, 1.48)	*
Japanese	1.15 (1.02, 1.29)	*	0.91 (0.76, 1.10)		1.44 (1.11, 1.89)	**	1.72 (1.37, 2.17)	***	1.04 (0.90, 1.19)		1.78 (1.44, 2.19)	***
Korean	0.71 (0.60, 0.85)	***	0.74 (0.57, 0.96)	*	1.22 (0.85, 1.75)		0.82 (0.57, 1.18)		0.69 (0.56, 0.84)	***	1.07 (0.80, 1.44)	
Vietnamese	0.88 (0.75, 1.02)		0.81 (0.64, 1.01)		1.59 (1.20, 2.11)	***	1.07 (0.80, 1.44)		0.86 (0.72, 1.03)		1.26 (0.99, 1.61)	
Other Asian	0.89 (0.75, 1.06)		1.09 (0.86, 1.39)		1.45 (1.04, 2.02)	*	1.33 (0.97, 1.82)		0.87 (0.71, 1.07)		1.18 (0.88, 1.59)	
Multiple race	1.42	***	1.49	***	2.74	***	2.22	***	1.30	***	1.91	***

Asian	(1.26,1.60)		(1.26, 1.76)		(2.19, 3.44)		(1.79, 2.75)		(1.14, 1.49)		(1.56, 2.33)	
Native Hawaiian	1.85 (1.62, 2.12)	***	1.76 (1.45, 2.12)	***	3.85 (3.01, 4.92)	***	3.59 (2.85, 4.52)	***	1.45 (1.24, 1.69)	***	3.05 (2.46, 3.79)	***
Other Pacific Islander	1.36 (1.18, 1.58)	***	1.42 (1.16, 1.74)	***	2.51 (1.95, 3.23)	***	2.21 (1.73, 2.84)	***	1.19 (1.01, 1.41)	*	1.65 (1.30, 2.10)	***
Race/Ethnicity x More Disadvantaged												
Chinese	1.00		1.00		1.00		1.00		1.00		1.00	
Asian Indian	1.66 (1.00, 2.73)	*	1.71 (0.94, 3.09)		1.70 (0.74, 3.90)		1.41 (0.66, 3.01)		1.54 (0.87, 2.72)		1.20 (0.57, 2.52)	
Filipino	1.09 (0.73, 1.64)		0.73 (0.40, 1.34)		0.88 (0.39, 1.99)		0.63 (0.27, 1.46)		1.13 (0.71, 1.79)		0.67 (0.35, 1.28)	
Japanese	—		—		—		—		—		—	
Korean	1.25 (0.71, 2.22)		—		—		—		1.12 (0.55, 2.28)		—	
Vietnamese	1.13 (0.69, 1.84)		0.99 (0.49, 2.03)		1.41 (0.62, 3.24)		—		0.91 (0.50, 1.66)		0.61 (0.28, 1.34)	
Other Asian	1.37 (0.79, 2.40)		0.52 (0.21, 1.26)		1.37 (0.54, 3.47)		1.75 (0.75, 4.07)		1.25 (0.65, 2.41)		—	
Multiple race Asian	1.17 (0.77, 1.77)		0.76 (0.43, 1.34)		1.05 (0.51, 2.15)		0.72 (0.35, 1.49)		0.99 (0.62, 1.59)		0.82 (0.45, 1.49)	
Native Hawaiian	1.03 (0.63, 1.89)		0.83 (0.39, 1.76)		1.43 (0.63, 3.27)		1.05 (0.46, 2.42)		1.63 (0.92, 2.87)		1.02 (0.50, 2.06)	
Other Pacific	1.05		1.04		1.45		0.81		1.06		0.69	

Islander	(0.72, 1.52)		(0.63, 1.69)		(0.77, 2.73)		(0.43, 1.52)		(0.69, 1.61)		(0.40, 1.21)	

* $p < 0.05$; ** $p < 0.01$; ***$p < 0$ .001

Abbreviations: *AOR* adjusted odds ratio; *CAD* coronary artery disease; *CHF* congestive heart failure; *CI* confidence intervals; *CVD* cardiovascular disease; *MI* myocardial infarction

Note: Dashes "–" are displayed for cells with less than 11 respondents following the CMS cell size suppression policy. Covariates included race/ethnicity, neighborhood disadvantage, interaction between race/ethnicity and neighborhood disadvantage, age, sex, marital status, educational level, income, Medicare/Medicaid status, diabetes, hypertension, body mass index (BMI), smoking status, survey year, whether a proxy completed the survey, and plan regional offices.

CHAPTER 5. INTEGRATIVE DICUSSION

Summary

The purpose of this dissertation was to understand CVD health disparities among Asian American and Native Hawaiian and Pacific Islander (NHPI) ethnic groups. Asian American and NHPI populations are culturally and linguistically diverse. Asian American and NHPI individuals also have unique profiles of settlement into the US, discriminatory experiences, and experiences with institutional racism that subsequently impact health care utilization and access and health outcomes (14,15). Despite these differences and the fact that they represent two distinct racial groups, data for Asian American and NHPI populations are typically reported as an aggregate group or not reported, which conceals health disparities that exist and paints a false picture.

The overarching goal of this dissertation was two-fold. The first goal was to characterize the heterogeneity of cardiovascular disease (CVD) risk factors and CVD conditions in disaggregated Asian American and NHPI ethnic groups. The second goal was to understand the effects of neighborhood-level characteristics on CVD outcomes. Three studies (Chapters 2 - 4) were conducted to achieve these goals: (1) analysis of the 2011-2015 Medicare Health Outcomes Survey (HOS) to determine the prevalence and determinants of CVD risk factors and CVD conditions among Asian American and NHPI ethnic groups and white adults; (2) analysis of the 2011-2015 Medicare HOS to assess the relationship between CVD conditions and health-related quality of life (HRQOL) among Asian American and NHPI ethnic groups and white

adults; and (3) analysis of the 2011-2015 Medicare HOS and 2015 Neighborhood Atlas data to investigate the relationship between neighborhood socioeconomic disadvantage and CVD conditions among Asian American and NHPI ethnic groups. The first manuscript found that the prevalence of being overweight and obesity, diabetes and hypertension was higher among the majority of Asian American and NHPI ethnic groups than white adults. There was substantial heterogeneity in the prevalence of CVD risk factors across each ethnic group. Filipino, Asian Indian and NHPI adults had some of the worst CVD risk factor profiles compared to white adults and other Asian American ethnic groups. Filipino men reported the highest prevalence of being overweight and obese and hypertension whereas Asian Indian men had greatest prevalence of diabetes. The majority of Asian American ethnic groups reported lower proportions of CAD, CHF, MI, other heart conditions and stroke than white adults. In contrast, NHPI adults reporter higher proportions of all CVD conditions and stroke compared to white adults. After adjustment, the majority of Asian American ethnic groups had statistically significantly lower odds of all CVD conditions and stroke compared to their white counterparts; there were mixed results among NHPI groups.

The second manuscript assessed the impact of CVD conditions on HRQOL among disaggregated Asian American and NHPI ethnic groups compared to white adults. HRQOL provides an assessment on physical limitations or depressive symptoms. This chapter was an extension of the first manuscript, to understand how CVD conditions impact health in older adults beyond mortality – as a potential pathway to focus intervention efforts on healthy aging. HRQOL was measured by the

physical component summary (PCS) and mental component summary (MCS) scores, where lower scores represent worse health. Adults who self-reported a CVD condition had lower PCS and MCS scores (worse health) than adults without CVD. There were notable differences in the magnitude of PCS and MCS scores across Asian American and NHPI ethnic groups, highlighting the need for data disaggregation to identify groups at greater risk of worse HRQOL. After adjustment, Asian American and NHPI ethnic groups had higher PCS (better physical health) but lower MCS (worse mental health) scores compared to white adults, though the differences were not statistically significant for all ethnic groups. A possible explanation is the healthy migrant effect for Asian Americans – where immigrants who come to the US are physically healthier than the non-migrant population. It is plausible that Vietnamese or Other Asian (e.g., Cambodian) adults who immigrated to the US during the Vietnam War would have been more physically able to endure escaping Vietnam (33). Additionally, the trauma suffered from the hardships of escaping the country would explain the worse mental health. I also conducted a separate analysis restricted to Asian American and NHPI ethnic groups where Japanese adults were the referent group. Most Asian American and NHPI ethnic groups had lower PCS and MCS scores compared to Japanese adults. There was significant differences in PCS and MCS scores by ethnic group – this within-group heterogeneity would have otherwise been masked without racial/ethnic group data.

The last manuscript investigated the relationship between neighborhood socioeconomic disadvantage on self-reported CVD conditions and stroke among Asian American and NHPI older adults. Older adults may be more vulnerable to

impacts from their proximal environments (i.e., neighborhoods) compared to younger adults (150). Understanding how neighborhood environments impact health can identify high-risk regions where more resources may be required. Overall, about 8% of respondents lived in more disadvantaged neighborhoods. Residence in more disadvantaged neighborhoods ranged from 2% in Japanese to 22% in Other Pacific Islander adults. Our unadjusted results showed that adults residing in more disadvantaged neighborhoods had greater odds of any CVD diagnosis, CAD, CHF, other heart conditions, and stroke compared to adults in less disadvantaged neighborhoods. Most interactions of race/ethnicity by disadvantaged neighborhoods were null which suggests that race/ethnicity did not moderate the relationship between living in more disadvantaged neighborhoods and CVD diagnoses. This could be explained because Chinese adults were the referent group. It is possible that if white adults were included in these analyses, there would have been stronger associations between neighborhood type and CVD conditions.

Integrative Conclusions

In addition to these results, there are common findings shared across all three studies related to CVD disparities in select racial/ethnic groups and the need for disaggregated data. When data were analyzed by the 10 unique Asian American and NHPI groups, we observed substantial variation by racial/ethnic group. Priority populations emerged that would have otherwise been masked. This dissertation presents evidence of disparities in CVD risk factors and mental health that refute the model minority stereotype where Asian American populations do not experience health disparities.

Native Hawaiian and Other Pacific Islander adults emerged as populations that disproportionately experienced worse CVD profiles. The first manuscript found that NHPI adults had higher proportions of obesity, diabetes, hypertension, and smoking compared to white and Asian American adults. Furthermore, the second manuscript found that NHPI adults had some of the worse HRQOL scores as compared with white and the majority of Asian American adults. The last manuscript found that Other Pacific Islander adults were more three times more likely to live in more disadvantaged neighborhoods compared to the Asian American group. The ability to separate NHPI from the Asian American category in this dissertation demonstrated the stark differences between these two racial groups. The majority of the research literature does not include NHPI individuals (4,48,151) which makes the health disparities of this population invisible and has resulted in a limited understanding of health among NHPI populations. When NHPI populations are included, they are combined with the Asian American category, which often masks their poor health outcomes. I was able to disaggregate NHPI into two groups – Native Hawaiian and Other Pacific Islanders, which revealed between-group variation. In the first manuscript, overall, NHPI adults reported a greater prevalence of obesity, diabetes, hypertension, and smoking than white adults. However, when NHPI data were further disaggregated into ethnic groups, Other Pacific Islander adults had higher rates of obesity, diabetes and hypertension compared to Native Hawaiians. In the last manuscript, I found that Other Pacific Islander adults were four times more likely to live in more disadvantaged neighborhoods than Native Hawaiian adults. The political designations of Native Hawaiians (e.g., indigenous people) versus Other

Pacific Islanders (e.g., non-immigrant status) also justify separating the NHPI ethnic groups. These findings indicate the need to separate NHPI from the Asian American category and further disaggregate NHPI ethnic groups when possible.

Our results also identified Multiple race Asian adults as a high-risk population among the Asian American racial group. The first manuscript found that Multiple race Asian men reported greater prevalence of stroke whereas Multiple race Asian women reported greater prevalence of CAD, CHF, compared to their white counterparts. Among the Asian American racial group, Multiple race Asian adults had the highest prevalence of smoking. Furthermore, the second manuscript found that Multiple race adults also had the worst overall physical health compared to other Asian American ethnic groups. The HOS LDS expanded racial/ethnic data allowed us to explore combinations of racial/ethnic groups and identify Multiple race Asian as another high-risk to focus on. Multiple race Asians are the fastest growing group within the Asian American racial category (92), and the need for more research on the mixed race individuals has been recognized (152). The experiences of acculturation, discriminatory experiences, and health care utilization may be different for the Multiple race Asian population compared to the single-race Asian population. Our results support the need to continue collecting data on detailed racial/ethnic categories in order to capture more accurate health information about mixed race individuals.

Contrary to the notion that Asian Americans do not experience health disparities, the dissertation found that Asian American and NHPI ethnic groups reported CVD risk factors more often and worse mental health compared to white adults. At first glance, the lower prevalence of CVD conditions among Asian

American ethnic groups compared to white adults suggests that Asian Americans are healthier. However, the first manuscript demonstrates that the prevalence of overweight, diabetes and hypertension was higher among the majority of Asian American than white adults. Despite reporting lower prevalence of CVD conditions, Asian American ethnic groups had worse CVD risk factors. The literature suggests that traditional CVD risk factors impact Asian American and NHPI groups differently than other racial groups (20), like body mass index (49). A recently published study hypothesized two pathways, including reduced beta cell function that impairs insulin secretion and low lean mass which impairs insulin action, to explain the high prevalence of type 2 diabetes at lower body mass index (BMI) thresholds among South Asians (153). The second manuscript found that compared to white adults, Asian American and NHPI ethnic groups reported worse MCS but better PCS. There was also variation in MCS and PCS scores by ethnicity, which suggests that the relationship with CVD risk factors and CVD conditions is complex. Moreover, the magnitude of difference in MCS scores were notably increased when we tested the moderating effect of race/ethnicity on HRQOL and CVD. Mental health conditions like depression are preventable. Given that a difference of one- to two-points in MCS scores is clinically meaningful (84,85), mental health should be a priority for future interventions to provide more holistic solutions to prevention and treatment efforts for CVD conditions. Disaggregated Asian American and NHPI data revealed that most ethnic groups had greater prevalence CVD risk factors and worse mental health than white adults – emphasizing that Asian American and NHPI groups do in fact

experience health disparities and the need to disaggregate data to accurately illustrate the heterogeneity in CVD and HRQOL across ethnic groups

Limitations

Beyond the limitations listed in each manuscript, there were broader limitations that should be acknowledged. First, the Medicare HOS cross-sectional design which did not allow us to make conclusions about the direction of the associations. We did not have information about severity of CVD risk factors or conditions, which may have resulted in underestimating the magnitude of the association with racial/ethnic group. The HOS data are self-reported and recall bias pertaining to diagnosis of CVD risk factors and conditions and race/ethnicity may have limited accuracy of the data. We hypothesized that immigration and acculturation factors related to the race/ethnicity would impact health services utilization and subsequently CVD health outcomes. However, the HOS did not provide information on health care use. The generalization of this research is limited to older adults enrolled in Medicare Advantage health plans. The HOS sampling biases against non-English or Spanish speaking individuals may have resulted in a sample of more English proficient adults answering the survey or older adults who have someone in their household who can speak English (proxy).

Second, the conceptual model based on Andersen and Newman's theory of health services utilization and Krieger's ecosocial theory allowed us to ground the research questions and selection of covariates in theory (27,28). However, our data did not allow us to test all of the theorized pathways. In the first manuscript we conducted sub analyses to explore the moderating effect of language mainly spoken at

home and English proficiency on the association between race/ethnicity and CVD. Similar to race/ethnicity, the main language spoken at home and English proficiency were selected as proxies for acculturation, immigration and discrimination experiences. However, these survey questions were not asked for all survey years and these two variables do not fully encompass the varied experiences of Asian American and NHPI ethnic groups. Future research should consider other ways to conceptualize and account for intersectional identities.

Third, although we were able to analyze data disaggregated for 10 Asian American and NHPI ethnic groups, we still ran into issues with small sample sizes when testing our hypotheses. For example, the HOS collect data on four NHPI groups (Native Hawaiian, Guamanian or Chamorro, Samoan, Other Pacific Islander). However, due to the small sample size for the Guamanian or Chamorro and Samoan groups, we still had to combine the categories which limits the generalizability of our results. Having some data on racial/ethnic minorities is not enough if we cannot describe the population or make conclusions about the specific group. The representation of adults in this survey may also be biased against individuals who did not speak English or Spanish. Although the HOS is a nationally-representative survey, because the sampling design did not oversample for racial/ethnic minorities, there may be geographic areas that have high densities of Asian American and NHPI groups that are represented by a few responses from the HOS. In the second manuscript, while we were able to link the Medicare HOS to the Neighborhood Atlas Area Deprivation Index (ADI), the sample size limited our ability to test other thresholds of neighborhood ADI. Furthermore, the sample sizes also limited our

ability to test mixed-effects models (hierarchical models) where individuals were nested in neighborhoods, because there few individuals were represented in each neighborhood.

Lastly, the referent group for each study varied based on the research question. The reference groups were white adults for the first manuscript, white and Japanese adults for the second manuscript, and Chinese adults for last manuscript. A main focus of this dissertation was to disaggregate Asian American and NHPI ethnic groups to understand the heterogeneity of CVD health across Asian American and NHPI populations. Grounded in our conceptualization of race/ethnicity as a social construct, I hypothesized that white adults would have better health because of their more favorable social status. White adults were included in analyses for the first and second manuscript to facilitate comparisons with prior research on CVD risk factors and CVD outcomes. For the second manuscript, we included Japanese adults as a reference group to investigate differences within Asian American and NHPI ethnic groups. The Japanese group was selected because of their different trajectory of acculturation into the US compared to other Asian American and NHPI groups, and they have the highest percent of US born individuals (89). I hypothesized that Japanese adults would also hold more favorable social status (and therefore better health) than other Asian American and NHPI groups.

For the third manuscript, I did not include white adults in the analyses to focus on the neighborhoods where Asian American and NHPI adults lived. The sample size for white adults would have potentially masked the relationships between neighborhood disadvantage and CVD conditions. I originally planned to have

Japanese adults as the referent group. However, when data were separated by neighborhood type and CVD conditions, the cell sizes for Japanese adults were too small to test hypotheses. Therefore, Chinese adults were selected as the referent group because of their long history in the US (similar to Japanese adults) and overall population size in the US (109,135,136). Despite the use of several reference groups, the issues surrounding which comparator group is most appropriate are not new for aging-related research among racial/ethnic minority populations (154). Future minority health research will require thoughtful considerations of understanding the between- and within-group heterogeneity of Asian American and NHPI ethnic groups.

Despite these limitations, this dissertation contributes to the larger literature on the current status of CVD health for disaggregated Asian American and NHPI ethnic groups. There is a dearth of research on older adults among Asian American and NHPI populations, as well the cumulative effects of neighborhood environments on health in these populations. This dissertation contributes to the field by providing detailed ethnic group information on the burden of CVD risk factors and CVD prevalence and describing the geographic regions and neighborhood types where Asian American and NHPI older adults reside.

Directions For Future Research

Our findings provide a current picture of Asian American and NHPI older adults and we describe some avenues for future work in these populations. First our use of a conceptual model guided by the theory of health services utilization and

ecosocial theory (27,28) allowed us to check our assumptions of who was represented in the data and develop a priori hypotheses. Recognizing that there is variation between Asian American and NHPI groups as well as within each ethnic group, future research should consider how to capture intersectional identities in research. Intersectionality is defined as the ways multiple forms of discrimination such as racism, classism and sexism combine or intersect (155). The role of discriminatory experiences related to culture, immigration, and acculturation experiences for Asian American and NHPI populations requires more detailed research. For example, studies could collect detailed data to understand pre-immigration, immigration, and post-immigration experiences that impact the pathways that lead to the development of diseases. Grounding future research in theories like ecosocial theory and intersectionality can help identify and understand health disparities within the larger context.

In terms of CVD risk factors, more information on health behaviors like diet or physical activity could provide information of individual-level behaviors that might explain the greater prevalence of CVD risk factors among Asian American and NHPI older adults. For CVD conditions, future research could investigate subtypes of stroke among Asian American and NHPI older adults. More research is needed for Asian American and NHPI to accurately understand baseline health profiles and health trends over time. Accurate depictions of CVD risk factors and CVD conditions by disaggregated Asian American and NHPI ethnic groups can better inform health programming.

Neighborhood environments are an important and exciting topic for understanding place-based influences on health, particularly for older adults who are potentially more limited to the proximal area around their homes. Future research should investigate how the cumulative impact of neighborhoods factors such as social capital, ethnic enclave or built environment characteristics impact health behaviors that protect or impede CVD health. This dissertation focused on a broad representation of the neighborhoods where Asian American and NHPI adults reside. Specific to the dissertation, future studies could investigate the role of individual socioeconomic position by disaggregated Asian American and NHPI subgroups and its relationship to neighborhood socioeconomic advantage. Future research should consider how neighborhoods were built and why there are large Asian American and NHPI populations in those areas. For example, resettlement camps were set up for Vietnamese refugees in 1975 (e.g., Camp Pendleton in San Diego, California) and Vietnamese populations ended up settling close to those areas (e.g., Orange County Little Saigon) (156). This context could be important to understand what neighborhood supports and resources are available and how neighborhoods have evolved or not evolved over time.

In depth investigations of specific neighborhood regions such as New York City may be more relevant and meaningful for the development of interventions or allocation of resources. Given the various definitions and ways to objectively measure neighborhood factors, it is important to collect qualitative data from Asian American and NHPI populations to cross-validate definitions of neighborhoods. Conducting research that is centered around individuals and the community can be important to

explain any phenomena that are observed, informing the relevant questions to ask, and providing context to inform more accurate interpretations of the data. For instance, qualitative data could provide detailed information about what is happening in the community, what resources and services are available, and whether the neighborhood analyses align with what individuals are experiencing.

Moving forward, it is important to collect and report disaggregated data so that public health professionals can better understand the health disparities that exist and mechanisms that perpetuate and exacerbate the health inequities. The growing racial/ethnic diversity and aging populations illustrate the need for better data standards, as these are opportunities to not only document health disparities but also provide evidence-based and data-driven policy recommendations. The 2020 Census ushers in more updated data that can be used to identify health disparities and high-risk populations. The 2020 Census is currently being provided in 59 languages. However, preliminary results from the 2020 Census Barriers, Attitudes, and Motivators Study (CBAMS) Survey reported that only 55% of Asian American were extremely likely or very likely to fill out the Census, compared to 69% of white individuals (157). This finding highlights the importance of intentional recruitment of Asian American and NHPI populations. It is unclear whether the current census will oversample for racial/ethnic minority adults. However, past evaluations of national surveys (13,21,112) as well as the HOS demonstrate the need to oversample for Asian American and NHPI populations to ensure that sample sizes are sufficiently powered to test research hypotheses. The growing Asian American and NHPI populations

require that disaggregated data are collected in order to identify and develop solutions to eliminate disparities as well as anticipate the future needs of the population.

Conclusion

The current social and political climate surrounding COVID-19 in the US and abroad have emboldened acts of xenophobia and racism against the Asian American community and brought to light the health disparities and inequities that exist. As public health professionals work to improve the health and health outcomes of racial/ethnic minority populations, it is important to acknowledge intersectional identities and to address the multilevel pathways of discrimination that contribute to health disparities. It has been 35 years since the Secretary's Task Force on Black and Minority Health Report (Heckler Report) was released concluding that Asian American and NHPI populations were the healthiest racial/ethnic group in the US (158). Although there have been great strides made to improve Asian American and NHPI, there is much work to be done. Our findings of greater prevalence of overweight and obesity, diabetes and hypertension as well as worse mental health among disaggregated Asian American and NHPI adults suggest there are still improvements to be made in prevention efforts for these groups. These papers highlight the importance of individual- and neighborhood-level factors as possible areas to prevent CVD as well as improve overall well-being for Asian American and NHPI adults in the US. It is critical that data disaggregation efforts continue in order to strengthen the movement towards health equity among Asian American and NHPI, as well as other racial/ethnic communities.

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APPENDIX

APPENDIX: LITERATURE REVIEW

Asian American and NHPI Population Projections

Asian American and NHPI populations represent more than 40 countries or cultures of origin, 100 different languages, and are projected to be the fastest growing racial and ethnic group in the US by 2060 (13,159,160). The Asian race alone or in combination is projected to increase 143.1% from 2014 to 2060, making up 11.7% of the total US population (159). The NHPI population is projected to increase 100.8% in the race alone or in combination category, to make up 0.7% of the total US population by 2060 (159). The demographic profile of Asian American and NHPI populations is further complicated when data are stratified by primary language, English-speaking ability, immigration status, and socioeconomic status (161). Asian American and NHPI individuals are more likely to speak a language other than English compared to white adults (162). Foreign-born NHPIs make up less than 1% of the total NHPI population (159). Overall, Asian American and NHPI racial groups have higher poverty rates than white adults, and Asian Americans have higher uninsured rates compared to white adults (162).

There is a paucity of data disaggregated by ethnic groups that has resulted in generalizations of health status and health outcomes across Asian American ethnic groups, and the perpetuation of the model minority myth (163–165). A particularly vulnerable group within the aggregate Asian race is immigrants, who may have limited English proficiency and social capital and resources. More than 90% of the Asian American population was foreign-born in 2014, with the majority of foreign-born Asian groups entering the US within the past 20 years (166). However, the

demographic landscape is quickly changing with the projection that about 50% of Asian American and NHPIs will be native born by 2030 (163). The variation in reception into the US and integration of immigrants into society, like where immigrants decide to settle and the neighborhood characteristics, are determinants that impact health and aging processes (167). Appendix Table 1.1 shows some examples of differences between Asian American and NHPI subgroups, including differences in historical context of immigration and settlement patterns.

The profiles of Asian American and NHPI older adults is complex. With the anticipated growth of the Asian populations in the United States and globally, it is important to understand the experience of Asian American and NHPI immigrants. Appendix Table 1.1 provides examples of interaction between US immigration policies and immigrants' sending country, that may have impacted the health status before and after immigration (168). For instance, variations in health within Asian American and NHPI ethnic groups is partly explained because of the different sociopolitical histories and waves of immigration to the US.

The impact of immigration and acculturation on health and health outcomes in Asian American and NHPI ethnic groups remains unclear (169). This is compounded by the lack of disaggregated data and resources to understand the different health trajectories of Asian Americans and NHPIs in the US. The evidence presented thus far supports the idea that Asian Americans, as a racial group, have better health outcomes due to the overall greater socioeconomic status (170). However when data are disaggregated, Asian American ethnic exhibit bimodal distributions in socioeconomic, education, and health outcomes (164,171). By bimodal distribution,

there is not a linear distribution for income. For example, within the Chinese group, there may be a similar percentage of individuals in the lowest income group and highest income group.

Frisbie et al. (2001) examined the effect of nativity and duration of residence in the US on the health of Asian American and NHPI s and found that foreign-born Asian Americans and NHPIs had better health outcomes and reported better perceived health, fewer activity restrictions, and fewer days in bed, compared to US-born Asian Americans and NHPIs (172). This study used National Health Interview Survey (NHIS) data between 1992 to 1995, and found that differences in health by API subgroup remained after controlling for immigrant status and the health status of foreign-born individuals became similar to that of US-born individuals with longer residence in the US (172). Similarly, recent immigrant cohorts (fewer years of life in the US) were less likely to report fair/poor health, compared to older immigrant cohorts (more years of life in the US) (173). Ro et al. (2015) found that longer duration of residence in the US was associated with increased obesity (173). These studies are examples of how the immigration experience and settlement in US could inform the dissertation research and theorize how these experiences are related to differences in health trajectories among Asian American and NHPI older adults.

Asian American and NHPI Older Adult Projections

The US population is projected to increase from 319 million to 417 million between 2014 and 2060 (159). Of the overall US population, the older population aged 65 and over is projected to increase from 15% to 24% (from 46 million to 98

million) in that same time period. The increase in individuals surviving past age 65 will result in greater mortality and morbidity, decreased health-related quality of life (HRQOL) (174) and increased economic impact (175). Multiple risk factors contribute to HRQOL and understanding how HRQOL differs by race/ethnicity will help identify appropriate interventions to inform future interventions to address the pending chronic disease burdens in the aging population. There is strong evidence that lower socioeconomic negatively impact health outcomes (62,176), stressing the threat for disparate CVD health in Asian American and NHPI older adults.

The Asian American and NHPI populations are projected to increase 128% and 63%, respectively, becoming the second and third fastest-growing groups from 2014 to 2060. As of 2012, Asian American and NHPI older adults made up 3.8% and 0.1% of the US older adult population, respectively (81). The Asian population aged 65 and over is expected to become the second-oldest racial category (19.4%) in the US (starting from 10.1%) while the NHPI aged 65 and over population is projected to increase to 17.7% by 2050 (starting from 6% in 2012) (81). The total Asian American and NHPI population is comprised of about 9% Asian American older adults and 6% NHPI older adults (8). Older Asian Americans and NHPIs are expected to grow 352% by 2060, to make up 21% of the total Asian American and NHPI population (8). More than half of Asian American and NHPI population aged 65 years or older are concentrated in three states, California, New York, and Hawaii (8). About 86% of Asian American and 27% of NHPI older adults are foreign-born, but ranges from 32.6% foreign-born in Samoans older adults to 99.1% foreign-born in Bangladeshi older adults (8). Less than 1 in 6 Asian American and NHPI older adult speaks

English at home, and about 60% of Asian American and. 30% of NHPI older adults are limited English proficient (8). When data for English proficiency are disaggregated for Asian American older adults, over 85% of Cambodian, Vietnamese, Hmong, and Laotian older adults reported speaking English less than "very well" (8). For NHPI older adults, Native Hawaiians (4%) reported being the least limited English proficiency and over two-thirds of Tongan older adults are limited English proficient (8).

The justification for focusing on older Asian American and NHPI groups is based on the Double Jeopardy Theory that states that minority older adults experience a double disadvantage to health due to age and racial discrimination (9,177). For example, having both older adult and minority status consequently results in worse health outcomes, compared to having one status (e.g., Vietnamese older adult versus white older adult). Double jeopardy interactions have been reported in a study on middle-aged and older African and Mexican, as the interactions between income and self-assessed health for Americans, compared to whites (9).

Model Minority Stereotype

The model minority is the stereotype that Asian Americans are hardworking, educated, and are not disadvantaged because they have achieved economic success as an aggregate, compared to other race/ethnicities (178). This stereotype has resulted in the assumption that Asian American and NHPI populations do not experience health disparities compared to other racial/ethnic group. This has had social and health implications such as lack of public service programming and funding for research in

Asian American and NHPI populations (19,178,179). For example, the landmark 1985 Report of the Secretary's Task Force on Black and Minority Health (Heckler Report) documented the existence of health disparities in Black, Hispanic, Native American, and Asian American and NHPI groups, but largely concluded that the Asian American and NHPI populations, as an aggregate, were healthier than all racial/ethnic groups in the United States (US) (158). This conclusion does not consider the diversity of Asian American and NHPI populations and that lumping the two racial groups together masks within-group differences.

The literature for Asian American and NHPI older adults have typically reinforced the model minority stereotype (164), reporting an immigrant advantage (e.g., only healthy individuals would immigrate to the US), mortality advantage (e.g., lower mortality rates compared to whites), and Asian-origin advantage (e.g., Asians have more advantaged socioeconomic conditions) (170,180,181). The prevailing stereotype that Asian Americans and NHPIs are model minority population (182) has resulted in a US health agenda that has not typically included Asian American and NHPI populations (178). Furthermore, many national dataset do not consistently collect Asian American and NHPI racial/ethnic group data, which results in data collection discrepancies (13,21,183,184). Data for Asian American and NHPI are also not consistently reported (e.g., sometimes data are presented for both groups combined, or just the Asian American group) (13,21,183,184). The paucity of health data disaggregated by Asian American and NHPI racial and ethnic groups has hindered the understanding of the distribution of the disease in Asian Americans and NHPIs (13,20,183,185–187).

Data Disaggregation

Asian American and NHPI individuals are understudied populations. The majority of studies do not disaggregate Asian American and NHPI individuals in their analysis, lump Asian Americans and NHPIs into one homogenous racial group, or simply exclude Asian American and NHPI groups from analyses because of small sample sizes or the assumption that Asian American and NHPIs do not experience health disparities (183,185,188). Studies that do include Asian American and NHPI s are also typically restricted to convenience samples or are based in a specific geographic location (20,185). However, when data are disaggregated for Asian American and NHPI older adults, there is variability in the health and socioeconomic differences across and within Asian American and NHPI ethnic groups (164). For example, in aggregate, liver cancer incidence and mortality are double the rate in Asian American and NHPI adults compared to white adults (189). When data are disaggregated, liver cancer incidence is 7 times higher for Laotian men and 9 times higher for Laotian women compared to white adults (189). Differences in health outcomes and subgroups at greater risk for worst health are highlighted when data are disaggregated.

This lack of information has consequently resulted in misleading assumptions about CVD health in Asian American and NHPI subgroups and the stereotype that Asians, as a combined racial group, have better health than all racial groups in the US (187). Waksberg et al. (2000) reported that of 15 federal databases, only the Census 2000 and American Community Survey (ACS) have adequate sample sizes that allow for meaningful data analysis of Asian Americans and NHPIs (190). The sample sizes

for Asian Americans and NHPIs in the other 12 databases, including the National Health Interview Survey (NHIS), National Health and Nutrition Examination Survey (NHANES), and Medical Expenditure Panel Survey (MEPS), only allow simple distributions or no data analysis of Asian Americans and NHPIs (190). Furthermore, measurement issues like inconsistent use and implementation of race/ethnic classifications, lack of appropriate cross-cultural data collection efforts, and inclusion of health disparities designated populations in research exacerbate our ability to understand health within and between Asian Americans and NHPIs (191). This knowledge gap is also exacerbated by the absence of older Asian American and NHPI participants in national surveys and research (16,17). Compared to white adults, health inequalities of Asian American and NHPI subgroups, especially in the later years, are expected to persist, magnify, or level out (170). In order to address pending health disparities in Asian American and NHPI older adults, it is important to understand general patterns in health now for these populations.

CVD and other age-related diseases

CVD is the leading cause of death in those aged 65 years and older (41,192). In 2010, an estimated 2 million deaths from heart disease, stroke, and hypertensive disease (underlying causal mechanisms of CVD) were avoidable, and death rates were highest among those 65 to 74 years old (401.5 per 100,000) (41). By 2030, the total projected annual medical expenditures attributable to CVD in adults 65 to 79 years old are projected to increase from $135 billion to $457 billion (193). CVD is preventable and treatable through better preventative health care and better treatment

(41,194). Yet, recent advances in CVD prevention and treatment have not translated to all economic and racial and ethnic groups, which underscores the need to address the social determinants of health in the diverse older adult population (62).

Pre-existing CVD and CVD risk factors are also associated with aging-related disease, like cognitive impairment (194–200), decline in functional status (201,202), frailty (203), and worse health-related quality of life (QOL) (204–206). There is strong evidence to support the associations of pre-existing CVD and CVD risk factors with diseases that have significant social and economic consequences (196), including incidence of cognitive decline (48) and Alzheimer's disease (195,198,200). CVD is a major cause of disability (69,202), and older adults who have CVD-related hospitalizations also experience declines in functional status (201). In addition, CVD is a predictor and cause of frailty (203,207). Prevalence of CVD has also been associated with impaired health-related QOL (204–206), which is important to assess as older adults live longer with more chronic conditions. A challenge to mitigating declines associated with aging will be how to reduce healthcare costs while increasing health-related QOL. Targeting modifiable CVD risk factors could prevent or delay onset of these age-related diseases (194,199,203). Furthermore, prevention is complicated because current CVD treatments and guidelines address one disease, which will have limited application as populations with multiple comorbidities grow (208).

Cardiovascular Disease in Asian American and NHPI adults

CVD is the leading cause of mortality for Asian Americans and NHPIs age 65 and older (41,192). However, CVD prevalence and CVD risk factors by disaggregated Asian American and NHPI group remains relatively unknown. The American Heart Association (AHA) conducted a review the literature on CVD in Asian Americans in a call to action to address health disparities in these populations and recommended better data collection in existing national surveys, development of more appropriate measures for Asian American subgroups, and more research studies for Asian Americans (20). Similarly, a systematic review of CVD interventions in minority population found that out of 62 interventions, Asians were represented in five interventions (209). Asians were represented in two hypertension interventions, one tobacco intervention, one lipids intervention, and one physical inactivity intervention (209).

Jose et al. (2014) investigated CVD mortality in Asian American and white adults in the US and found that overall CVD mortality decreased steadily for white adults from 2003 to 2010, but remained the same or increased for Asian subgroups (3). Compared to white adults, all Asian subgroups had a greater proportionate mortality (i.e., CVD accounts for a larger percent of Asian American groups than white adults) from hypertensive disease (except for Vietnamese) and hemorrhagic stroke (3). White men and women have the highest overall mortality rates, but Asian Indian men and women and Filipino men had a higher proportionate mortality burden (CVD accounts for a larger percent of deaths in Asian subgroups by sex) from ischemic heart disease (210).Filipinos, Japanese, and Vietnamese had greater mortality from cerebrovascular diseases, compared to white adults (3). There was also

variation between men and women, with women having greater CVD mortality in most disease types (3). The heterogeneity in CVD across Asian American women is also comparable to prior studies (211). An investigation on CVD mortality in a population-based sample of Native Hawaiians found that CVD mortality accounted for 56% of deaths in men and 54% in women, with the majority of deaths due to myocardial infarctions and coronary heart diseases (4). For Native Hawaiians, there were higher rates of CVD mortality in men compared to women (4). Filipino women were more likely to have a stroke compared to white adults, in a mixed-payer, outpatient health care organization in California . There is a general consensus that heterogeneity exists across Asian Americans and NHPIs, and that some Asian American and NHPI subgroups are at greater risk for CVD mortality. Overall, these examples support the view that CVD morbidity and mortality patterns are largely obscured for Asian Americans and NHPIs due to limited disaggregated statistics.

In regards to genetic determinants of CVD, there have been observed gene-environment interactions based on genome-wide association studies (GWAS) on coronary artery disease and stroke mortality (20). These findings suggest differences in CVD health based on geographic location, which is important to consider for potential changes in CVD health based on immigration to the US (20). Few studies have also suggested differences in metabolism of cardiac drugs, however, previous studies are limited to international Asian American populations which does not take into account for geographic differences in health or the immigrant pathways (20). Research on GWAS and cardiac medications in Asian American populations has also been mostly restricted to few subgroups (20).

Cardiovascular Risk Factors in Asian American and NHPI adults

The distribution of CVD risk factors like hypertension, diabetes, and body mass index (BMI) vary by Asian American and NHPI ethnic group and the importance of these risk factors across Asian American and NHPI subgroups is not fully understood (20,212). Compared to white adults, Filipino and Japanese adults have a greater prevalence of hypertension, and Asian Indians, Filipinos, and Native Hawaiian and Pacific Islanders have reported higher rates of diabetes, compared to white adults (213–217). Another study found that East/Southeast Asians had a significantly higher risk of hypertension than white adults using the New York City Health and Nutrition Examination Survey (215).Prior research has demonstrated that diabetes is a major determinant for CVD in NHPI populations (4,151). For dyslipidemia (cholesterol), Frank et al. (2014) reported that compared to white adults, all Asian American ethnic groups had increased prevalence of high triglycerides (TG) and Asian Indians, Filipinos and Vietnamese had increased prevalence of low high-density lipoprotein cholesterol (LDL-C) (218). Asian Indian, Filipino and Vietnamese women and Asian Indian men were high-risk populations for three subtypes of dyslipidemia (218).

Patterson et al. (2016) examined the prevalence of CVD health in three Asian American subgroups, based on the American Heart Association's metrics for ideal CVD health (e.g., tobacco use, BMI, physical activity, dietary intake, blood pressure, and glucose) (219). Three in five adults (64.9%) were overweight or obese based on ASIAN AMERICAN-specific BMI threshold and four in five adults (80.6%) did not

achieve the ideal physical activity (≥ 75 min/week of vigorous activity or ≥ 150 min/week of moderate activity) (219). Thirty-four percent had poor or moderate blood pressure readings and almost three-quarters of the sample (71.1%) had poor or moderator glucose readings) (219). Existing literature suggests that Asian Indian, Filipino, Japanese, Vietnamese, and Native Hawaiian and Pacific Islander adults have a greater prevalence of physical inactivity than white adults (185,213,217,220).

Compared to white adults, Asian Americans as an aggregate have been reported to have lower prevalence of overweight, obesity, and diabetes using standard BMI thresholds (221). However, evidence presented thus far supports using lower BMI thresholds for Asian American to more accurately categorize those overweight and obesity (49,221). In other words, compared to European populations, Asian Americans have lower BMIs for the same age and percentages of body fat. Normal/underweight Asian adults also have a higher prevalence of hypertension than normal/underweight white adults, suggesting that Asians may be at increased risk for CVD morbidities at normal weight using traditional body mass index (BMI) cut points (215,222). The suggested thresholds for Asian Americans are underweight <18.5 kg/m_2, normal = 18.5-<23 kg/m_2, overweight = 23-27.5 kg/m_2, obese ≥ 27.5 kg/m_2.

At-risk or high-risk populations for CVD risk factors will be underreported if standard BMI thresholds are used for Asian American populations. This can be seen in a case study examining the association between the standard versus Asian-specific BMI thresholds and CVD risk factors in Chinese adults aged 18 and over (223). There was a greater prevalence of high blood pressure, high cholesterol, and diabetes

using the lower Asian-specific BMI thresholds and that overweight Chinese adults (BMI ≥ 27.5) self-reported greater prevalence of CVD risk factors compared to normal weight adults (BMI <23.0) (223). Similarly, population-based study using the Asian-specific BMI thresholds found the adjusted prevalence of overweight/obesity in Filipinos was higher than white adults and that Filipinos, Vietnamese, Korean, South Asians and Japanese adults have higher diabetes prevalence at lower BMI cut points (49). Filipinos have also been reported to have the highest mean BMI in a systematic review of overweight, obesity, and type 2 diabetes among Asian Americans (212). These results suggest that traditional BMI thresholds are not accurately identifying Asian American and NHPI individuals who are at high-risk for CVD risk factors, increasing the probability for undetected CVD morbidities and of CVD mortality.

In contrast, a prospective cohort investigating BMI and mortality in Asian American adults as an aggregate found that high BMI was associated with increased total mortality, but did not find increased mortality at lower Asian-specific BMI thresholds (224). This study may have found opposite results because Asian Americans and NHPIs were categorized together, masking the risk of mortality differences across Asian American and NHPI ethnic groups.

Neighborhood Impacts on Minority Health

Examining health by ethnicity and age is important, however, it is not sufficient in fully explaining health differences and requires considering factors beyond the individual level. Efforts to understand and eliminate the social

determinants of health requires a focus on the context and communities in which individuals live. Prior research has found that individuals living in poor, deprived, or socioeconomically deprived neighborhoods have greater mortality, poorer self-reported health, greater incidence of cardiovascular disease, and greater prevalence of chronic conditions like obesity and hypertension (225).

The specific purpose of the proposed project is to look at neighborhood social environments and health. Examples of the social environment include census measures of socioeconomics or racial/ethnic composition of neighborhoods. Recent work by Kaiser et al. (2017) found that neighborhoods with high socioeconomic and low minority populations had better social and physical environments, compared to low socioeconomic and high minority neighborhoods. This is supported by past findings where greater social cohesion, social capital and relationships with neighbors is associated with less depression, better health, and lower CVD incidence and mortality (34). The Multi-Ethnic Study of Atherosclerosis (MESA) Neighborhood Study has also found that neighborhoods with better physical and social environments had lower rates of incident hypertension, compared to neighborhoods with worst environments (225). Similarly, Kind et al. (2015) found that in the most socioeconomically disadvantaged neighborhoods, risk of 30-day rehospitalization rates was 27% greater, compared to least disadvantaged neighborhoods in the US (131).

Neighborhood characteristics are important to the understanding of how CVD risk is distributed across Asian Americans and NHPIs because socioeconomically disadvantaged neighborhoods are associated with the worst CVD outcomes

(139,226,227). Few studies have investigated the relationship between neighborhood context and CVD health in Asian American and NHPI subgroups. The studies that have been conducted in this area have been limited to associations in a single Asian subgroup (115,139,226,228). Prior research on neighborhood socioeconomic characteristics has been associated with greater CVD mortality (229–231), higher prevalence of coronary heart disease (229,230), and CVD risk factors (139). A prospective study of Japanese men living in Japan, Hawaii, and California found that men living in California had the highest age-adjusted prevalence of coronary heart disease and highest prevalence of angina pectoris (115). This study suggests differences in health status based on geographic location and national origin. Neighborhood context is important to understanding the underlying reasons for CVD disparities.

Neighborhoods by Nativity and Socioeconomic Status

Other factors that may be important in understanding immigrant health and aging is where these immigrants reside during first arrival to the US and how characteristics of the neighborhoods influence immigrant health and aging. Salant & Lauderdale (2003) demonstrate that residence in ethnic enclaves serve as a possible deterrent for integration into society, regardless of number of years in the US (232). Ethnic neighborhoods present specific environmental contexts that have been shown to both positively and negatively impact health (233). The few studies examining Asian immigrant health and older adults have predominately been focused on

California, adult populations, and individual health and health outcomes or neighborhood characteristics only.

Previous studies have illustrated that Asian Americans tend to live in Asian ethnic neighborhoods and report better physical health outcomes and greater positive health behaviors when residing in neighborhoods with other Asians (144). For Asian immigrants, these residences in ethnic-dense neighborhoods have typically been in metropolitan areas. Walton defines three types of ethnic neighborhood based on nativity and socioeconomic status (SES): immigrant enclave (low SES and foreign-born); community of constraint (US-born and low-SES); and resurgent community (high SES and foreign-born or high SES and US-born) (144). Immigrant enclaves are predominately filled with low-skill immigrants and the assumption is that immigrants rely on each other in these enclaves for social, cultural, economic and language help until they are able to reach a higher socioeconomic status to move (144). Communities of constraint result from discrimination that results in the mixing of ethnic groups in neighborhoods and neighborhood mixing based on individual- and group-level traits (144). Communities of constraint are characterized by higher ethnic density and worst outcomes (144,234). Walton describes resurgent communities where immigrants who come from high SES backgrounds are able to benefit from living in multiethnic spaces compared to living in predominately white areas (144).

The literature examining immigrant health has generally focused on the influence of acculturation on health but requires understanding cultural factors within the larger context of social determinants of health (168). With projected shifts towards a majority minority nation and an aging population with multi-morbidities, it

is imperative to start addressing strategies at multiple levels (individual, community, institutional) to ensure the best health possible for everyone, especially the most vulnerable populations.

In a study on the differences in health based on ethnic neighborhood typology, Walton (2015) found that immigrants living in communities of constraint and immigrant enclaves reported worse health, compared to those living in resurgent communities (144) (Appendix Table 1.2). When neighborhood type and ethnic subgroup were analyzed together, Vietnamese Americans were less likely to report good health if they lived in communities of constraint and immigrant enclaves (only ethnicity remained significant in the adjusted models) (144). A strength of this study is the breakdown of ethnic neighborhood environments to understand its impact on individual health by ethnic subgroup. As duration of residence in the US increases for Asian immigrants, it is important to shift the thinking from immigrants only residing to immigrant enclaves to understanding if and where immigrants move after attaining greater SES and social status.

In another study on resurgent communities, Walton (2012) found similar neighborhood-level characteristics across Asian ethnic neighborhoods, where neighborhoods with more than 12 years of education is associated with better individual health (234). However, when individual-level demographic variables were included in the multilevel analyses, the effect of neighborhoods varied by ethnic subgroup (234). This study highlights that neighborhood-level characteristics impact individual-level health differently by ethnic subgroup.

Limitations of these studies are that it examines health outcomes at one time point and is geographically limited to California. Although a large majority of Asian Americans reside on the West Coast, it is also important to understand how ethnic neighborhoods across the US might differentially impact health behaviors and health of immigrants. This cross-sectional analysis does not address how health status changes across time or how it might change with upward mobility of individuals and families, or how health and aging is situated in the neighborhood context. The study design is restricted to a single Asian ethnicity and does not address acculturation domains like years of residence in the US or age at migration (for foreign-born individuals). The author also focused on overall health outcome and did not extend studies to examine change in health behaviors based on environmental context. The studies reviewed show similar limitations in a cross-sectional view of individual-health and social context in ecological psychology and epidemiology. These studies also did not investigate how health behaviors might influence health outcomes in older adults.

Asian American and NHPI adults in the HOS

Few studies have included disaggregated Asian American and NHPI subgroups using Medicare HOS data, particularly for CVD health. The Medicare HOS is typically used as a linked dataset with the Surveillance, Epidemiology and End Results (SEER) data for research on cancer patients enrolled in Medicare Advantage Organizations (235–237). In an investigation of HRQOL among cancer survivors, Asian cancer survivors reported higher physical health scores (e.g., better

better) compared to other racial/ethnic groups [5]. One of the limitations with this interpretation is that it does not explain differences across ethnic subgroups, which is important to understand the underlying reasons to explain why Asians experienced better physical health compared to other race/ethnicities. Another study on receipt of preventative care among minority older adults reported that compared to white adults, Asians were more likely to receive care to reduce risk of failing and monitor physical activity, and compared to other minority groups, there were no significant improvements in services for Asians over time (238). This study reveals the need for further investigation in Medicare Advantage preventative services received by Asian American and NHPI subgroups, which is important to reduce CVD risk factors like physical inactivity (238). The research utilizing the Medicare HOS to date has tended to focus on Asians as an aggregate, lump Asians into the 'Other' category, or reported descriptive data of Asian American and NHPI subgroups.

Aging Well as Person-Environment Interchange

This framework is specific to the interplay of aging well in the environment. The two assumptions of this framework are that there are two processes at play, experience-driven belonging and behavior-driven agency (239). Experience-driven belonging describes an individual's connection and satisfaction with the environment, and behavior-driven agency is an individual's ability to change health outcomes through intentional and proactive behaviors (239). This framework extends traditional aging models by placing older adults in the context of environments and takes into account older adults' ability to be proactive and reactive in an environment (239).

Similar to previous theoretical perspectives, this framework also emphasizes person-environment resources, where the levels of importance for personal resources depends on the environment, and are essential to individual agency and utilizing the resources of the environment (239). For example, individual resources like physical abilities to walk without any balance problems, would negatively impact an individual's agency if they lived in a home environment with stairs. The physical environment decreases the individual's agency because of in ability to change their situation (e.g., navigating stairs). Belonging and agency are also placed within the life course and historical contexts. The life course perspective places emphasis on belonging because as older adults age, there is an increased emphasis on the resources and role of the home and community environment (239). Historical and cultural context refers to the interaction between the environment and older age, that is influenced by individual status in relation to the environment (239).

The framework emphasizes:

a) that understanding the relationships between environments, agency, and belonging is important to predicting aging well;
b) sense of belonging within the environment is important in older age, especially in older adults with major functional limitations;
c) the inverse relationships between agency and belonging differs across the life course (e.g., agency becomes less important while belonging becomes more important in more advance age); and
d) that the relationship between agency and belonging in the environment are complicated and vary based on historical and cultural context (239).

Appendix Table 1.1. Demographic characteristics and immigration history

Race/Ethnicity	Demographic and immigration characteristics
Chinese	Chinese Americans came to the US for labor positions in the gold minds and transcontinental railroads in the early 1800s (33). The majority of Chinese Americans post-1965 were from urban areas, and half of immigrants were white-collar workers or educated immigrants and half were low-wage earners (33). Most older adults immigrating from China come for family reunification (33).
Filipino	Filipino immigrants came to the US as laborers in the Gulf Coast and on plantations starting in the 1760s (20,33). Most immigrants post-1985 immigrants were professionals (33). The Immigration Act of 1990 also allowed Filipinos to gain US citizenship through military service during World War II (33). Many Filipinos are multilingual in English and Spanish because of colonization by the Spanish (20).
Japanese	Most Japanese immigrants came in the late 1800s as laborers (240). Almost 3 out of 4 Japanese American older adults were native-born as of the US Census 2000 (33). Japanese Americans, on average, have lived in the US for longer than other Asian American ethnic groups (33).
Korean	Korean Americans started coming to the US in the 1900s for labor positions (20,33). Post-1965 immigration laws increased immigration of Korean medical professionals, and recent immigrants are in the retail and service industries (33).
Vietnamese	Vietnamese immigrants who came to the US at the end of the Vietnam War in the 1975 were highly skilled and educated because of their work with the government (33). The second wave of immigrants (between 1978 to mid-1980s) were ‘boat people’ (those who escaped the on boats), and suffered hardships because of the Communist government and having to escape the country (33). The last wave of Vietnamese refugees came to the US through legislation for family reunification, and were survivors of Communist reeducation camps (33).

Appendix Table 1.2. Neighborhoods based on nativity and socioeconomic status

Neighborhoods below are based on nativity and socioeconomic status (144).

Nativity		Low Socioeconomic status	High Socioeconomic status
	U.S. Born	Community of Constraint	Resurgent Community
	Foreign Born	Immigrant Enclave	Resurgent Community

Neighborhoods	Categories	Dataset
Community of Constraint (US-born and low-SES)	Neighborhood cluster has: <30 percent foreign born <$60,000 median household income <25 percent college graduates	2010 Census
Immigrant enclave (low SES and foreign-born)	Neighborhood cluster has: ≥30 percent foreign born <$60,000 median household income <25 percent college graduates	2010 Census
Resurgent Community (high SES and foreign-born or high SES and US-born)	Neighborhood cluster has: ≥$60,000 median household income ≥25 percent college graduates	2010 Census

Appendix Table 1.3. Medicare Health Outcomes Survey Questions

Dependent Variable: Cardiovascular Disease

Domains	Questions	Response Categories
Coronary artery disease	Has a doctor ever told you that you had: Angina/Coronary Artery Disease?	0= No 1= Yes
Congestive heart failure	Has a doctor ever told you that you had: Congestive heart failure?	0= No 1= Yes
Myocardial infarction	Has a doctor ever told you that you had: a myocardial infarction or heart attack?	0= No 1= Yes
Other heart conditions	Has a doctor ever told you that you had: Other heart conditions, such as problems with heart valves or the rhythm of your heartbeat?	0= No 1= Yes
Stroke	Has a doctor ever told you that you had: a stroke?	0= No 1= Yes

Dependent Variable: Health-related Quality of Life

Domains	Questions	Response Categories
General Health	In general, would you say your health is:	1 = Excellent 2 = Very good 3 = Good 4 = Fair 5 = Poor
Physical Functioning	The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf Climbing several flights of stairs	1 = Yes, limited a lot 2 = Yes, limited a little 3 = No, not limited at all
Role-Physical	During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health? Accomplished less than you would	1 = No, none of the time 2 = Yes, a little of the time 3 = Yes, some of the time 4 = Yes, most of the time 5 = Yes, all of the time

	like as a result of your physical health? Were limited in the kind of work or other activities as result of your physical health?	
Role-Emotional	During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? Accomplished less than you would like as a result of any emotional problems Didn't do work or other activities as carefully as usual as a result of any emotional problems	1 = No, none of the time 2 = Yes, a little of the time 3 = Yes, some of the time 4 = Yes, most of the time 5 = Yes, all of the time
Bodily Pain	During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	1 = Not at all 2 = A little bit 3 = Moderately 4 = Quite a bit 5 = Extremely
Vitality/Mental Health	How much of the time during the past 4 weeks: Have you felt calm and peaceful? Did you have a lot of energy? Have you felt downhearted and blue?	1 = All of the time 2 = Most of the time 3 = A good bit of the time 4 = Some of the time 5 = A little of the time 6 = None of the time
Social Functioning	During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?	1 = All of the time 2 = Most of the time 3 = Some of the time 4 = A little of the time 5 = None of the time
Physical Health Compared to One Year Ago	Compared to one year ago, how would you rate your physical health in general now?	1 = Much better 2 = Slightly better 3 = About the same 4 = Slightly worse 5 = Much worse
Emotional Health Compared to One Year Ago	Compared to one year ago, how would you rate your emotional problems (such as feeling anxious, depressed or irritable) in general now?	1 = Much better 2 = Slightly better 3 = About the same 4 = Slightly worse 5 = Much worse

Primary Independent Variable: Race/Ethnicity

Domains	Questions	Response Categories
Hispanic or Latino/a	Are you of Hispanic or Latino origin or descent?	0 = No, not Hispanic or Latino 1 = Yes, Hispanic or Latino
Race	What is your race? (One or more categories may be selected)	[white, Black or African American, American Indian or Alaska Native, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other Asian, Native Hawaiian, Guamanian or Chamorro, Samoan, or Other Pacific Islander]

Individual-Level Risk Factors

Domains	Questions	Response Categories
Physical Inactivity	In the past 12 months, did a doctor or other health provider advise you to start, increase or maintain your level of exercise or physical activity? For example, in order to improve your health, your doctor or other health provider may advise you to start taking the stairs, increase walking from 10 to 20 minutes every day or to maintain your current exercise program.	0= No 1= Yes
Body mass index	BMI = [Weight in pounds/(Height in inches)2] x 703	Calculated Body Mass Index
Hypertension	Has a doctor ever told you that you had: Hypertension or high blood pressure?	0= No 1= Yes
Diabetes	Has a doctor ever told you that you had: Diabetes, high blood sugar, or sugar in the urine	0= No 1= Yes
Smoking status	Do you now smoke every day, some days, or not at all?	1 = Every day 2 = Some days 3 = Not at all

		4= Don't know

Individual-Level Covariates: Pre-disposing factors

Domains	Questions	Response Categories
Age	What is your age?	0 = No, not Hispanic or Latino 1 = Yes, Hispanic or Latino
Sex	Beneficiary's sex from the baseline member level record. This information is derived from CMS databases.	1 = Male 2 = Female
Marital Status	What is your current marital status?	1 = Married 2 = Divorced 3 = Separated 4 = Widowed 5 = Never married
Living Arrangement	Do you live alone or with others?(One or more categories may be selected)	[Alone, With spouse/ significant other, With child/ other relatives, With non-relatives, With paid caregiver]
Education	What is the highest grade or level of school that you have completed?	1 = Did not graduate from high school 2 = High school graduate or GED 3 = Some college or 2-year degree 4 = Four-year college degree or more
Language Proficiency	How well do you speak English?	1 = Very well 2 = Well 3 = Not well 4 = Not at all

Individual-Level Covariates: Enabling factors

Domains	Questions	Response Categories
Income	Which of the following categories best represents the combined income for all family members in your household for the past 12 months?	1 = Less than $5,000 2 = $5,000 - $9,999 3 = $10,000 - $19,999 4 = $20,000 - $29,999 5= $30,000 - $39,999 6 = $40,000 - $49,999 7 = $50,000 - $79,999 8 = $80,000 - $99,999

		9 = $100,000 or more 10 = Don't know
Medicaid Status	Beneficiary's Medicaid status at baseline. This information is derived from CMS databases.	0 = Out of Medicaid 1 = In Medicaid
Medicare Advantage Organization	Plan's regional office code as derived from the regional office listed in the HPMS Plan Contract List at the time of the baseline survey administration	1 = Boston 2 = New York 3 = Philadelphia 4 = Atlanta 5 = Chicago 6 = Dallas 7 = Kansas City 8 = Denver 9 = San Francisco 10 = Seattle
Who Completed this Survey Question	Who completed this survey form?	1 = Person to whom survey was addressed 2 = Family member or relative of person to whom the survey was addressed 3 = Friend of person to whom the survey was addressed 4 = Professional caregiver of person to whom the survey was addressed