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Racial and Ethnic Differences in Self-Reported Periodontal Disease in the Multi-Ethnic Study of Atherosclerosis (MESA)

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Abstract

Purpose—Racial and ethnic disparities in periodontal disease exist in the United States. This study examined the prevalence of self-reported periodontal disease, and the extent to which racial/ethnic disparities in the reported disease were reduced or eliminated after controlling for various risk factors in a multi-ethnic study population of older adults.

Materials and Methods—Information from the baseline examination (July 2000–August 2002) of the Multi-Ethnic Study of Atherosclerosis (MESA) was used. Study participants (N=6,256) were age 45–84 years, and identified themselves as either: White, Black, Hispanic, or Chinese. Periodontal disease was assessed by self-report, and demographic, socioeconomic status (SES) indicators, biomedical risk factors, and psychosocial stress factors were used as predictors of self-reported periodontal disease.

Results—Chinese displayed the highest prevalence of self-reported periodontal disease (39.8%), followed by blacks (32.0%) and whites (26.0%), with Hispanics displaying the lowest prevalence (17.4%). Chinese and black participants had a significantly higher prevalence of disease compared to whites that persisted after adjusting for demographic, SES indicators, biomedical risk factors, and psychosocial stress factors. Hispanics did not differ significantly from whites in their reporting of disease, after such adjustment.

Conclusion—Racial/ethnic disparities in self-reported periodontal disease persisted after adjusting for all study covariates. This study highlights the need for continued research into the determinants of racial/ethnic disparities in periodontal disease in order to better target interventions aimed at reducing the burden of disease in all segments of our population.

Keywords

Race; Ethnicity; Periodontal diseases; Healthcare Disparities; Minority Health

INTRODUCTION

Periodontal disease is a chronic disease affecting approximately 47% of adults (64 million people) in the United States.[9] As the disease progresses, it can ultimately lead to tooth loss and compromise masticatory function, speech, esthetics, and the quality of life.[11] The burden of periodontal disease is not equally distributed in the population as minorities and individuals of lower socioeconomic status (SES) experience a greater prevalence of disease compared to their counterparts.[9] The elimination of oral health disparities in the U.S. based on race/ethnicity and SES has been a fundamental goal of public health since the 2000 Surgeon General's Report on Oral Health.[24]

Studies examining racial/ethnic differences in the prevalence of periodontal disease in older adults often control for SES and well-established risk factors to explain such differences, however, these disparities persist after such adjustment.[4,5,8] For instance, using the third National Health and Nutrition Examination Survey (NHANES III) to examine the periodontal health of adults aged 50 years and older, Borrell *et al.* found that blacks had a higher prevalence of periodontitis than their white and Mexican American counterparts, with their increased odds of disease persisting even after controlling for SES and other established risk factors.[5] While racial/ethnic disparities in periodontal disease have been well documented [4,5,8], very little is known about the prevalence of the disease in Asian Americans, a racial/ethnic group with a 43% population increase in the U.S. between 2000 and 2010.[10] Thus, it is imperative to examine the periodontal disease burden in Asian American subgroups to determine how they compare to other racial/ethnic groups in the U.S.

"Race" is a multi-dimensional construct inherently associated with several difficult-to-measure exposures that can affect periodontal health, either directly or indirectly.[12,26] Stress is among the exposures captured by race, and may help explain racial/ethnic disparities in periodontal disease. Black and Hispanic Americans may be exposed to greater levels of stressors, including discrimination, than their white counterparts.[22,27] Furthermore, exposure to stress has been shown to be a risk factor for periodontitis.[17] Thus, it is possible that stressors could explain the effect of race/ethnicity on periodontal disease.

The presence of periodontal disease can be assessed in various ways, with self-report being a time and cost-effective way to assess its burden in epidemiologic studies.[23] Taylor and Borgnakke analyzed the associations between self-reported periodontal disease questions and clinical examination findings, and concluded that self-report of periodontal disease may be valid to assess periodontal disease status in in large epidemiologic studies.[23]

The availability of a self-reported periodontal disease measure along with socio-demographic characteristics, biomedical risk factors, and psychosocial stress factors in the Multi-Ethnic Study of Atherosclerosis (MESA); enables us to hypothesize that after controlling for these risk factors and indicators, racial/ethnic disparities in self-reported periodontal disease will be reduced or eliminated in the study population. Furthermore, we hope to gain insights into the periodontal health status of Chinese Americans, for whom there is currently sparse data in national datasets examining oral health measures.

MATERIALS AND METHODS

Study population

MESA is a prospective study investigating the risk factors of subclinical atherosclerosis in a cohort of 6,814 men and women from four racial/ethnic groups (black, white, Hispanic, and Chinese). These participants were age 45 to 84, free from cardiovascular disease at baseline (July 2000–August 2002), and were recruited from the following study sites: New York, NY (Columbia University); Baltimore, MD (Johns Hopkins University); Chicago, IL (Northwestern University); Los Angeles, CA (University of California, Los Angeles); St. Paul, MN (University of Minnesota); and Winston Salem, NC (Wake Forest University). All participants were provided with informed consent, and the study was approved by institutional review boards at each study site. A complete description of the MESA study design and objectives has been previously described.[3]

Outcome of interest

Consistent with previous studies, periodontal disease was ascertained by self-report from participants.[20] Specifically, participants were classified as having periodontal disease if they had an affirmative response to the following question: Has a dentist ever told you that you had periodontitis or gum disease?[20] People who were unsure or had missing information for this question were excluded from further analyses.

Exposure of interest

Race/ethnicity was determined by self-report from participants who identified themselves as one of the U.S. Census-defined racial/ethnic groups on the MESA-administered survey. Participants that identified themselves as Hispanic were classified as such regardless of their racial background. This study was restricted to those participants who identified themselves as one of the following four racial/ethnic groups: White/Caucasian, Black/African-American, Hispanic, or Chinese.

Socio-demographic and biomedical risk factor covariates

Socio-demographic and medical history information was collected from all participants using a technician-administered questionnaire. Consistent with previous studies describing risk factors and indicators for periodontal disease [2,6], the following measures were considered as covariates: age, gender, education, income, health insurance status, BMI, smoking status and diabetes. Age was collected and categorized into the following 10 year age groups based on the distribution of the study population: 45 – 54, 55 – 64, 65 – 74, and 75 – 84 years. Education was categorized as: less than high school, high school, some college/technical school, and college degree and beyond. Total family income had the following categories: $24,999, $25,000–49,999, $50,000–74,999, and $75,000 or greater. Insurance status was dichotomized into those having some form of health insurance (i.e. HMO/private, Medicare, Medicaid, military, or other type) and those without any health insurance.

Diabetes status was collected and categorized into the following categories based on the 2003 American Diabetes Association fasting criteria algorithm: Normal, Impaired Fasting Glucose (IFG), Treated Diabetes, and Untreated Diabetes. It was then dichotomized into non-diabetic (Normal and IFG) and diabetic (Untreated and Treated Diabetes) based on the distribution in the study population. Smoking status was collected and categorized as: never, former, and current smokers. Finally, BMI, which was calculated based on collected height and weight measurements, was dichotomized into non-obese (BMI <30 kg/m^2) and obese (30 kg/m^2).

Psychosocial Stress covariates

Chronic Burden and Perceived Lifetime Discrimination were analyzed to measure the amount of stress experienced by participants. A complete description of how these covariates were measured has been previously described.[16] Briefly, the Chronic Burden scale consisted of the following five sources of chronic burden experienced for at least 6 months: health problems (self), health problems (someone close to individual), job difficulties, financial strain, and relationship problems.[16,19] The five sources of chronic burden were summed (for a minimum score of 0 and a maximum score of 5), and then categorized into three categories based on the total (0, 1, and 2 or greater). The categories were chosen based on the distribution of scores in the study population.

Perceived Lifetime Discrimination was used to measure whether participants had ever been discriminated in their lifetime in the following six ways: unfairly fired/denied promotion, unfairly denied employment, treated unfairly by the police, treated unfairly by neighbors,

unfairly discouraged by a teacher, or unfairly prevented from moving into a neighborhood.[16,25] Participants were also asked the reason for the discrimination (i.e.: race/ethnicity, gender, religion, etc.). The six ways that a participant could experience discrimination in his/her lifetime were summed (for a minimum score of 0 and a maximum score of 6), and then categorized into three categories based on the total (0, 1, and 2 or greater), irrespective of the reason for the discrimination. The categories were chosen based on the distribution of scores in the study population.

Statistical analysis

Of the 6,814 MESA participants, 558 individuals were excluded from analysis due to having incomplete baseline information for either: self-reported periodontal disease, socio-demographics, biomedical risk factors, or psychosocial stress factors. Only participants with complete baseline information for all study variables were included in the analysis. This yielded an analytic sample of 6,256 participants.

Descriptive statistics for the previously described covariates were presented for the study population and by race/ethnicity. The prevalence of self-reported periodontal disease was also presented for each covariate overall and by race/ethnicity. Chi-square statistics were used to determine independent associations of selected characteristics' distribution and the prevalence of self-reported periodontal disease by race/ethnicity.

Log-binomial regression models were used to estimate prevalence ratios to assess the strength of the association between race/ethnicity and self-reported periodontal disease before and after controlling for the selected covariates. Specifically, the following models were used: Crude model- with race/ethnicity as the only independent variable; Model 1- adjusting for age and gender (demographic covariates); Model 2- model 1 + education/income/insurance status (SES covariates); Model 3- model 2 + diabetes status/smoking status/BMI (biomedical covariates); Model 4- model 3 + chronic burden and perceived discrimination lifetime (psychosocial stress covariates). All statistical analyses were performed using SAS version 9.3 (SAS Institute, Inc., Cary, NC.).

RESULTS

Table 1 shows the overall and racial/ethnic-specific characteristics of the study population. The overall study population was roughly, equally distributed amongst the age groups and by gender. The majority of participants had post-high school education; had health insurance; were not current smokers; were non-diabetic; and were non-obese. Income levels varied, as did the level of psychosocial stressors that participants experienced.

All study covariates except for age showed a significant association with race/ethnicity (P value < .05; Table 1). Whites displayed higher levels of income and education than the overall study population, while Hispanics displayed lower income and education levels than the overall study population. Blacks and whites had higher proportions of participants with health insurance than Hispanics and Chinese. Chinese participants were less likely to smoke or be obese than the overall study population, while black participants were more likely to be current smokers and obese than the overall study population. Chinese reported lower

levels of chronic burden and perceived discrimination than the other groups, while blacks reported higher levels of the stress measures than the overall study population.

Table 2 shows the prevalence of self-reported periodontal disease for selected covariates overall and within each racial/ethnic group. Chinese displayed the highest overall prevalence of self-reported periodontal disease (39.8%), followed by blacks (32.0%) and whites (26.0%), with Hispanics displaying the lowest prevalence (17.4%; P <.0001). The prevalence of disease with age varied by race/ethnicity, with whites and Chinese displaying the lowest prevalence in the oldest age group, while blacks and Hispanics displayed the highest prevalence in the oldest age group. Black and white females displayed higher levels of disease than their male counterparts, while the opposite was seen for Hispanic and Chinese females. Among all racial/ethnic groups, the prevalence of self-reported disease was seen to be the lowest among the least educated (< high school degree), and tended to be higher among those in the higher income categories. In all racial/ethnic groups except for whites, those with health insurance reported more disease than those without it. In all racial/ethnic groups, those reporting stress displayed a higher prevalence of disease than those not reporting stress. Self-reported periodontal disease showed a significant association with race/ethnicity after adjusting for each covariate separately (P value <.0001; Table 2).

Table 3 displays the unadjusted and adjusted prevalence ratios (PR) and 95% confidence intervals (CI) of self-reported periodontal disease by race/ethnicity. In the unadjusted model, compared to whites, Chinese had the highest probability of self-reported disease (PR= 1.53; CI=1.37, 1.71), followed by blacks (PR=1.23; CI=1.12, 1.36); while Hispanics exhibited the lowest (PR= 0.67; CI= 0.59, 0.77). After controlling for demographic characteristics (Model 1), the prevalence ratios were unchanged for all racial/ethnic groups compared to their white counterparts. However, the prevalence of disease increased for all racial/ethnic groups relative to whites after including SES indicators into the model (Model 2). When biomedical risk factors were added into the model (Model 3), the prevalence ratio slightly increased for Chinese participants, and remained similar for blacks and Hispanics. In the fully-adjusted model (Model 4) that included psychosocial stress covariates, the prevalence ratios were unchanged: Hispanics (PR= 0.88; CI= 0.76, 1.02), blacks (PR= 1.25; CI= 1.13, 1.39), and Chinese (PR= 1.92; CI= 1.71, 2.17).

DISCUSSION

This study found that Chinese and black participants in MESA had a significantly higher prevalence of self-reported periodontal disease than whites and Hispanics, with Chinese participants displaying the greatest prevalence and Hispanics displaying the lowest prevalence. This finding remained in the fully adjusted analyses where Chinese and blacks had a significantly higher prevalence of self-reported periodontal disease relative to their white counterparts, while Hispanics did not differ significantly from whites in their reporting of disease.

Consistent with previous studies [4,5,8] and despite using a self-reported measure, our study found that black participants had a higher prevalence of periodontal disease relative to whites after adjusting for all study covariates. Additionally, and consistent with previous

studies focusing on Mexican Americans [4,5,8], we found that Hispanics (comprised of Mexican/Mexican American (52.9%), Puerto Rican (14.1%), Dominican (11.8%), Cuban (3.9%), and other Hispanics (17.3%)) had similar prevalence of periodontal disease relative to whites after adjusting for all study covariates.

Traditionally, SES measures have been found to partially explain racial/ethnic differences in periodontal disease.[8] However, in this study SES indicators did not reduce observed disparities when included in the regression models. The present study uses self-report to assess disease status in contrast to clinical measurements used in NHANES studies.[1,4,5,7] The measure used in this study also mentions a professional diagnosis ("has a dentist ever told you"), and requires the person to be under the care of a dentist, which is less likely among those individuals of lower SES.[14] Thus, the use of self-report to assess periodontal disease likely contributed to less reporting of disease amongst individuals of lower SES, therefore, mitigating the effect of SES.

It is possible that some of the racial/ethnic differences in self-reported periodontal disease observed in our study could be due to racial/ethnic differences in health literacy and English proficiency.[21] Health literacy is the ability to obtain, process, and understand health information to make appropriate health decisions, and is critical to understanding health information.[13] Racial/ethnic minorities have been shown to have lower health literacy than their counterparts.[13] Additionally, individuals from Asian and Hispanic ethnic groups are more likely to have limited English proficiency compared to whites, which can impact their health literacy and health status.[21]

A study examining health literacy and limited English proficiency in Asians and Hispanics, found that low health literacy and limited English proficiency were associated with poor self-reported health status.[21] Since we were unable to control for health literacy or limited English proficiency, it is possible that these factors could help explain the racial/ethnic differences in self-reported periodontal disease observed in our study. However, given that Hispanics displayed the lowest prevalence and Chinese displayed the highest prevalence of self-reported periodontal disease, yet both of these groups face similar health literacy and limited English proficiency challenges [21], it is likely that these racial/ethnic differences in reported periodontal health status are explained by additional factors, which require further investigation.

A major strength of this study lies in the racial/ethnic diversity of its participants. Very little is known about how the periodontal health status of Chinese, the largest Asian subgroup in the U.S. [10], compares to other racial/ethnic groups in this country. It was troubling to see that this group displayed the greatest prevalence of self-reported periodontal disease, and had nearly two-times the prevalence of self-reported periodontal disease compared to whites even after controlling for all study covariates. Surprisingly, Chinese had higher education levels, less smokers, less obesity, and lower stress than the overall study population- a risk profile that would suggest lower levels of reported disease.[2,6,17] These results indicate that Chinese (and perhaps other Asian subgroups) may have additional risk factors specific to this racial/ethnic group, which deserve further investigation.

Another strength of this study was the availability of stress measures, which allowed us to explore if the observed racial/ethnic disparities in periodontal disease may be explained by differences in stress. Although there was an increase in self-reported periodontal disease prevalence in all racial/ethnic groups in those reporting stress, the inclusion of stress in the regression model did not explain much of the differences in periodontal disease by race/ethnicity as hypothesized. Future studies should continue to investigate the role that stress may play in the racial/ethnic disparities observed in periodontal disease.

There were some limitations in this study to note. The use of self-report as opposed to a clinical examination did not allow us to differentiate between different levels of severity of periodontal disease. "Periodontal disease" is a broad term that encompasses milder forms of disease such as gingivitis, and more chronic and advanced forms of periodontitis.[11,18] The question used in this study was only able to ascertain whether participants had periodontitis *or* gum disease (gingivitis). Additionally, the use of self-report potentially introduced bias that could have affected the study outcome. If a participant was not under the care of a dentist or had infrequent dental utilization, the dentist would not be able to communicate the periodontal health status to the participant, and he or she would probably be less likely to report periodontal disease. Also, some patients may not recall whether they had been told that they have periodontal disease while other patients (especially those with a more serious form of periodontal disease) could be more likely to report disease. Finally, because dentist communication is variable [15], some dentists may do a good job of communicating to patients their periodontal health status while others may not, which could have impacted how patients answered this self-report question. However; the stark racial/ethnic differences noted in disease reporting, especially amongst a Chinese group that is under-represented in U.S. studies, still provides important information that should be further investigated in future studies. In addition, with the exception of Chinese (for whom there is sparse data on their periodontal disease prevalence in the U.S.), this studies' findings are similar to racial/ethnic differences in periodontal disease seen in other U.S. studies that have used a clinical measure as opposed to self-report.[4,5,8]

It is important to remember that MESA study participants were cardiovascular disease-free at baseline. Therefore, the selection of healthier people at older ages could help to explain the unexpected decrease in disease prevalence in the oldest age group observed in whites and Chinese. Finally, this study did not collect any information about oral health behaviors or the frequency of dental visits. The latter would have provided more information on access to care.

Despite using a self-reported measure, our findings suggest that racial/ethnic disparities in periodontal disease continue to persist and indicate that the burden of periodontal disease is not shared equally across different minority groups. The high prevalence of periodontal disease reported in Chinese suggests that future studies on racial/ethnic disparities in periodontal health should examine this group and other Asian American subgroups to better understand their prevalence and risk factors. As the U.S. becomes more diverse, it is imperative that we fully understand the risk factors of periodontal disease in all racial/ethnic groups to better target interventions to reduce the burden of disease in all segments of our population.

Acknowledgments

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Table 1

Distribution of selected characteristics of MESA study participants overall and by racial/ethnic group at baseline examination: 2000–2002

Covariates	Overall (N=6256), %	Whites (n=2450), %	Blacks (n=1642), %	Hispanics (n=1400), %	Chinese (n=764), %	P-value [a]
Age Categories (years)						0.1863
45 – 54	29.0	28.1	29.7	30.9	27.0	
55 – 64	27.9	27.6	28.6	28.0	27.6	
65 – 74	29.6	30.4	29.9	27.5	30.1	
75 – 84	13.5	14.0	11.8	13.6	15.3	
Gender						0.0214
Male	47.4	48.2	44.2	48.9	49.0	
Female	52.6	51.8	55.9	51.1	51.1	
Education Categories						<.0001
<HS diploma	17.8	4.8	11.1	44.6	24.6	
HS diploma	17.6	16.2	18.3	20.3	16.1	
Some College/Tech school	23.5	24.0	28.9	21.6	13.7	
College degree +	41.1	55.1	41.8	13.5	45.6	
Income Categories						<.0001
$24,999	31.3	15.8	30.2	49.9	49.4	
$25,000–49,999	28.6	26.3	31.9	32.4	22.0	
$50,000–74,999	17.1	20.8	20.0	10.5	11.3	
$75,000+	23.0	39.2	18.0	7.2	17.4	
Health Insurance						<.0001
Yes	91.2	97.4	93.9	82.6	81.8	
No	8.8	2.7	6.2	17.4	18.2	
Smoking status						<.0001
Never	50.5	44.2	45.9	53.7	75.1	
Former	36.6	44.3	36.5	32.9	19.4	
Current	12.8	11.5	17.7	13.4	5.5	
BMI Categories						<.0001
Non-obese (<30 kg/m^2)	68.1	72.1	54.3	62.4	95.6	
Obese (30 kg/m^2)	31.9	27.9	45.7	37.6	4.5	

Covariates	Overall (N=6256), %	Whites (n=2450), %	Blacks (n=1642),%	Hispanics (n=1400),%	Chinese (n=764), %	P-value [a]
Diabetes Status						<.0001
Non-diabetic	87.6	94.2	82.8	82.1	86.5	
Diabetic	12.5	5.8	17.2	17.9	13.5	
Chronic Burden						<.0001
0	38.4	35.7	34.3	37.7	57.6	
1	31.0	32.7	30.2	32.3	24.6	
2 or more	30.6	31.6	35.5	30.0	17.8	
Perceived Discrimination						<.0001
0	57.8	62.4	38.7	60.1	80.1	
1	22.3	23.7	25.6	21.6	12.0	
2 or more	19.9	14.0	35.7	18.3	7.9	

[a] P value from Chi-square test of independence for categorical variables and race/ethnicity

MESA- Multi Ethnic Study of Atherosclerosis; HS- High School; BMI- Body Mass Index

Table 2

Prevalence of self-reported periodontal disease for selected covariates overall and among each racial/ethnic group in the MESA baseline examination: 2000–2002

Covariates	Overall %	Whites %	Blacks %	Hispanics %	Chinese %	P-value [b]
Self-Reported Periodontal Disease	27.3	26.0	32.0	17.4	39.8	<.0001 [a]
Age Categories (years)						<.0001
45 – 54	26.5	23.1	34.8	18.1	35.9	
55 – 64	29.1	29.2	30.3	17.9	46.9	
65 – 74	28.1	28.0	32.4	16.4	39.1	
75 – 84	23.8	21.1	35.0	28.4	17.3	
Gender						<.0001
Male	26.6	23.6	31.6	18.4	41.2	
Female	28.0	28.2	32.4	16.5	38.5	
Education Categories						<.0001
<HS diploma	16.4	15.4	20.3	10.9	31.4	
HS diploma	25.4	23.5	28.0	16.2	46.3	
Some College/Tech school	30.2	28.4	31.0	27.5	43.8	
College degree +	31.3	26.5	37.6	24.9	40.8	
Income Categories						<.0001
$24,999	22.9	23.0	26.1	12.5	38.2	
$25,000–49,999	28.2	28.4	32.9	20.7	33.3	
$50,000–74,999	29.9	23.6	36.3	26.5	48.8	
$75,000+	30.3	26.8	35.8	23.8	46.6	
Health Insurance						<.0001
Yes	27.8	25.8	32.2	19.1	41.0	
No	22.1	30.8	29.7	9.5	34.5	
Smoking status						<.0001
Never	24.5	19.2	29.1	16.2	39.2	
Former	30.5	31.4	34.9	19.1	40.5	
Current	29.7	30.9	33.8	18.1	45.2	
BMI Categories						<.0001

Covariates	Overall %	Whites %	Blacks %	Hispanics %	Chinese %	P-value [b]
Non-obese (<30 kg/m²)	28.4	26.3	34.2	17.3	39.3	
Obese (≥30 kg/m²)	25.2	25.0	29.5	17.7	50.0	
Diabetes Status						<.0001
Non- diabetic	27.3	26.2	32.1	17.0	39.3	
Diabetic	27.6	22.4	31.8	19.6	42.7	
Chronic Burden						<.0001
0	25.6	21.4	32.5	15.5	37.1	
1	26.9	27.6	28.4	16.2	45.7	
2 or more	30.0	29.5	34.7	21.2	40.4	
Perceived Discrimination						<.0001
0	25.6	24.5	30.4	13.4	39.9	
1	28.1	27.2	29.9	23.4	40.2	
2 or more	31.7	30.4	35.3	23.4	38.3	

[a] P-value from Chi-square test of independence for self-reported periodontal disease and race/ethnicity

[b] P-value from Mantel-Haenzel Chi-square test of independence for self-reported periodontal disease and race/ethnicity, after controlling for each covariate separately

MESA- Multi Ethnic Study of Atherosclerosis; HS- High School; BMI- Body Mass Index

Table 3

Unadjusted and adjusted prevalence ratios [a,b,c,d,e] (and 95% confidence intervals) of self-reported periodontal disease for race/ethnicity in the MESA baseline examination: 2000–2002

	Crude	Model 1	Model 2	Model 3	Model 4
Race/Ethnicity					
Whites (ref)	1.00	1.00	1.00	1.00	1.00
Blacks	1.23 (1.12, 1.36)	1.22 (1.11, 1.35)	1.29 (1.17, 1.42)	1.29 (1.17, 1.43)	1.25 (1.13, 1.39)
Hispanics	0.67 (0.59, 0.77)	0.67 (0.59, 0.77)	0.87 (0.75, 1.00)	0.89 (0.77, 1.02)	0.88 (0.76, 1.02)
Chinese	1.53 (1.37, 1.71)	1.53 (1.37, 1.71)	1.76 (1.57, 1.97)	1.87 (1.66, 2.10)	1.92 (1.71, 2.17)

[a] Crude model adjusts for: race/ethnicity

[b] Model1 adjusts for: Crude+ age and gender

[c] Model 2 adjusts for: Model 1 + education, income, health insurance

[d] Model 3 adjusts for: Model 2+ smoking status, BMI category, diabetes status

[e] Model 4 adjusts for: Model 3 + chronic burden and perceived discrimination