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Hearing Impairment Prevalence and Associated Risk Factors in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)

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Abstract

Importance—Hearing impairment (HI) is a common problem in adults but there have been few studies of hearing in the U.S. Hispanic/Latino population. Little is known about factors associated with HI among Hispanics/Latinos.

Objective—To determine the prevalence of HI among U.S. Hispanic/Latino adults of diverse backgrounds and determine associations with sociodemographic factors, noise exposure, diabetes, smoking, cardiovascular disease, and other potential risk factors.

Design and Setting—The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) is a population-based sample of Hispanics/Latinos in four U.S. communities (Bronx, NY, Chicago, IL, Miami, FL, and San Diego, CA). Examinations were conducted in 2008–2011.

Participants—The HCHS/SOL examined 16,415 self-identified Hispanic/Latino persons aged 18 to 74 years recruited from randomly selected households using a stratified 2-stage area probability sample design based on census block groups and households within block groups.

Intervention(s)—None

Main Outcome(s) and Measures—Hearing thresholds were measured by pure-tone audiometry. HI was defined as a pure-tone average (PTA) of thresholds at 0.5,1,2,4 kHz >25 dB HL. Bilateral hearing impairment (BHI) required a PTA>25 dB HL in both ears. Multivariable analyses included adjustments for sociodemographic and lifestyle variables, body mass index, and medical conditions.

Results—The prevalence of HI was 15.1% overall and 8.2% had BHI. The prevalence of HI was higher among people aged 45 and older, ranging by Hispanic/Latino background from 29–41% among men and 18–31% among women. The multivariable-adjusted odds of HI was greater for participants of Puerto Rican background compared to Mexican background (OR =1.57, 95%CI=1.10, 2.25). The odds of HI were lower with more education and higher income. People with noise exposure were about 30% more likely to have HI. Diabetes (OR=1.57, 95%CI= 1.27, 1.94) and pre-diabetes (OR=1.37, 95%CI= 1.12, 1.67) were associated with higher odds of HI.

Conclusions and Relevance—HI is a common problem for older Hispanics/Latinos in these communities and is associated with socioeconomic factors, noise exposure and abnormal glucose metabolism. Longitudinal studies are needed to determine if these factors are involved in the etiology of HI and to identify ways to prevent or delay age-related changes in hearing.

Keywords

Hearing impairment; presbycusis; Hispanic; prevalence; risk factors; diabetes

INTRODUCTION

Hearing Impairment (HI) is one of the most common chronic conditions affecting adults but data specific to the Hispanic/Latino population have been limited.[1–3] In the Hispanic Health and Nutrition Examination Survey (HHANES) conducted between 1982 and 1984, the prevalence of HI among men aged 55–74 years varied by Hispanic/Latino background, ranging from 46% among Mexican Americans and 48% among Cuban Americans to only 23% among Puerto Rican participants.[1] Among women the rates varied slightly with 35%, 43% and 33% of Mexican American, Cuban American, and Puerto Rican participants having HI, respectively.[1] More recently reports from the National Health and Nutrition Examination Survey (NHANES), have suggested that HI is less common among Mexican Americans than Non-Hispanic whites (NHW) but did not provide data about other Hispanic/Latino backgrounds.[2] Other large U.S. cohort studies[4–7] include few Hispanic/Latino participants, leaving large gaps in knowledge about the prevalence, impact, unmet health care needs, and factors associated with HI among Hispanic/Latino populations.

There is growing evidence that age-related HI may be associated with lower socioeconomic status (SES), noisy jobs, diabetes, smoking, and obesity, risk factors that may be more common among the Hispanic/Latino population.[3,6,8–13] HI may lead to lower quality of life and be associated with increased risk of dementia.[14–24] Most people with HI are undiagnosed and untreated, an unmet need for health care which may be exacerbated in groups typically underserved for health care.[25–27] The purpose of this study was to determine the prevalence of HI among Hispanic/Latino adults from diverse backgrounds and to identify factors associated with HI among Hispanics/Latinos.

METHODS

The HCHS/SOL is a population-based cohort study of Hispanics/Latinos in four U.S. cities (Bronx, New York; Chicago, Illinois; Miami, Florida; San Diego, California) which was designed to examine risk and protective factors for chronic diseases by Hispanic/Latino background. Detailed descriptions of the sampling methods and baseline examination (2008–2011) have been presented previously.[28–30] The HCHS/SOL examined 16,415 self-identified Hispanic/Latino persons aged 18 to 74 years recruited from randomly selected households. The largest background groups were Central American (n=1,730), Cuban (n=2,348), Dominican (n=1,460), Mexican (n=6,471), Puerto Rican (n=2,728), and South American (n=1,068). Households were selected using a stratified 2-stage area probability sample design based on census block groups and households within each sampled block group. Oversampling occurred at each stage, with block groups in areas of Hispanic/Latino concentration, households associated with a Hispanic/Latino surname, and persons aged 45 to 74 years selected at higher rates than their counterparts. All reported values (means and prevalence rates) were weighted to account for the disproportionate selection of the sample

and to at least partially adjust for any bias effects due to differential nonresponse in the selected sample at the household and person levels. The adjusted weights were also trimmed to limit precision losses due to the variability of the adjusted weights, and calibrated to the 2010 Census characteristics by age, sex and Hispanic background in each field site's target population. All analyses also accounted for cluster sampling and the use of stratification in sample selection. The study was approved by institutional review boards at each participating institution; written informed consent was obtained from all participants.

Hearing Examination Methods

All technicians were centrally trained and certified by the EpiSense Audiometry Reading (EAR) Center at the University of Wisconsin. Detailed protocols are available on line at http://www.cscc.unc.edu/hchs/.

Ambient sound levels were measured daily at each test site.[31] GSI 61 clinical audiometers (Grason-Stadler, Inc., Madison, WI) equipped with TDH-50P and insert earphones (E-A-Rtone 3A, Cabot Safety Corp., Indianapolis, IN) were calibrated annually according to ANSI standards.[32] A brief otoscopic examination and screening tympanogram (Earscan®, Micro Audiometrics, Murphy, North Carolina) were obtained to assist in identifying obstructing cerumen and middle ear disease. Hearing thresholds were measured in sound-treated booths by pure tone air (0.5, 1, 2, 3, 4, 6, 8 kHz) and bone conduction (0.5, 2, 4 kHz) audiometry using a modified Hughson-Westlake procedure according to the guidelines of the American Speech-Language-Hearing Association.[33] Masking was used as necessary. The presence of hearing impairment was defined as a pure-tone average (PTA) of thresholds at 0.5,1, 2, 4 kHz greater than 25 decibels Hearing Level (dB HL) in either ear. A second definition of PTA > 25 dB HL in the better ear was also used to capture bilateral hearing impairment. This four frequency average has long been used as a measure of hearing impairment in epidemiologic studies.[34]

Sociodemographic (education and income), lifestyle and medical history data were obtained by questionnaires administered in English or Spanish. Participants were asked about smoking (never, former and current) and alcohol consumption (never, former, current). History of cardiovascular disease (CVD) including myocardial infarction, angina, stroke or transient ischemic attacks was ascertained. History of noise exposure was considered positive if the participant reported using firearms, military service or exposure to loud noises during leisure time. Occupational noise exposure was defined as a current or former job which was noisy (had to speak in a raised voice or louder to be heard two feet away). The longest held job was categorized as professional/managerial/technical, service, or production/manufacturing/labor.

Hypertension was defined as a systolic blood pressure 140 mm Hg or greater, diastolic blood pressure 90 mm Hg or greater, or receiving antihypertensive medication.[30,35] Diabetes mellitus was a fasting plasma glucose 126 mg/dL or greater, 2-hour-postload plasma glucose 200 mg/dL or greater, an HbA1c 6.5% or greater, self-report of doctor-diagnosed diabetes (excluding gestational diabetes) or use of antihyperglycemic medications.[30,36] Pre-diabetes was a fasting plasma glucose between 100–125 mg/dL, 2-hour-postload plasma glucose between 140–199 mg/dL or an HbA1c between 5.7–6.4%. Height was measured to the

nearest centimeter and weight to the nearest 0.1 kg. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared.

Statistical Analyses

All reported values (means, prevalence, and odds ratios [ORs]) were weighted to adjust for sampling probability and nonresponse. Age-adjusted prevalence estimates for the target population of Hispanics/Latinos in the four HCHS/SOL communities were calculated using survey-specific logistic regression procedures adjusting each subgroup to the age distribution of the target population. Survey-specific logistic regression analyses were used to examine associations of risk factors with HI. Initial models adjusted for age, sex, center, and Hispanic background. Multivariable models adjusted for all covariates shown. Odds ratios with 95% CIs were computed using survey-specific logistic regression procedures to account for the 2-stage sampling design, stratification, and clustering. Age groups were collapsed to ages 18–44 and 45+ to ensure good precision of prevalence estimates; the cut-point reflects the original study design which oversampled the 45+ age group. All analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC) and SUDAAN Release 10.0.0 (RTI, Research Triangle Park, NC).

RESULTS

The descriptive characteristics of the study participants (unweighted) and the sample population (weighted) are shown in Table 1. In the weighted sample, 52% were female and 40.5% were age 45 years or older, the age range when age-related hearing loss would present. Only 0.85% reported a history of ear surgery or disease. Overall, 15.06% (Standard error (SE) = 0.44) had hearing impairment, and about half of these (8.24%, SE=0.33) had bilateral hearing impairment (Table 2). Only a small proportion of those with hearing impairment (either ear or bilateral) had some evidence of conductive hearing problems as 3.12% (SE=0.19) of left ears and 2.92% (SE=0.17) of right ears demonstrated an air-bone gap of 15 dB or more.

In general, the prevalence of hearing impairment was higher among men and older age groups (Table 2). Among men 18–44 years of age, the prevalence of hearing impairment in either ear ranged from 2.68% among men reporting South American background to 7.14% among men of Puerto Rican background (Table 2). Similarly, among men 45 years of age or older, the prevalence of hearing impairment (in either ear) was highest among men reporting Puerto Rican background (41.20%) and varied among the other groups with a low of 29.35% among men with Dominican background.

The prevalence of HI also varied among women by Hispanic/Latino background (Table 2). For women ages 18–44 years, the prevalence ranged from a high of 8.14% among participants reporting Puerto Rican background to a low of 2.72% among those reporting South American background. Older women (age 45+ years) who reported mixed/other background had a prevalence of 32.11% and the lowest prevalence was among the women of Mexican background (17.89%). As expected, the prevalence of bilateral hearing impairment was substantially lower in all groups of men and women, but the patterns were

similar, with higher prevalence among participants reporting Puerto Rican background and lower prevalence among persons of South American background.

Adjusting for age, gender, center, and Hispanic/Latino background, indicators of higher socioeconomic status were associated with lower prevalence (Table 3). Greater education was associated with a 30% lower prevalence of HI (Odds Ratio (OR) = 0.71 for a high school diploma or equivalent vs none, 95% Confidence Interval (CI) = 0.61, 0.83). Those with the highest income level were significantly less likely to have HI than people with the lowest income (OR=0.56, 95% CI = 0.29, 0.73 for $75,000 vs <$10,000). People with diabetes had a 50% increased odds of HI. Obesity, current smoking, history of cardiovascular disease, service sector occupations, former exposure to occupational noise, and noise exposure history were associated with greater odds of hearing impairment (Table 3). Associations with bilateral hearing impairment (BHI) were very similar (Table 3), although statistical significance varied slightly.

In the multivariable-adjusted model (Table 4), age was strongly associated with HI; people 65 years of age or older had an 18.5-fold (95%CI = 12.40, 27.68) greater prevalence of HI compared to younger adults (ages 18–44 years). Greater education and higher income remained protective with effect sizes similar to the simpler models. Compared to Mexican background, Puerto Rican background remained associated with increased odds of HI (OR=1.57, 95%CI=1.10, 2.25); there were no other Hispanic/Latino background groups with higher or lower odds of HI. Exposure to noise from firearms and leisure activities as well as former exposure to occupational noise were associated with increased odds of HI. Having diabetes, and pre-diabetes, was associated with significantly increased odds of HI. CVD history, hypertension, BMI, smoking, and alcohol were retained in the model, although not significantly associated with HI. The bilateral hearing impairment model showed similar associations; in addition, hypertension and former but not current alcohol consumption were independently associated with increased odds of bilateral hearing impairments.

DISCUSSION

In this study of U.S. Hispanics/Latinos from diverse backgrounds, HI was common among adults and the prevalence increased sharply after age 45 years. This finding is consistent with results from studies in other populations and with the national data from the NHANES.[1–7] As in other studies men were more likely to have HI than women. Unlike the early HHANES[1] in the 1980s, Puerto Rican background was associated with higher prevalence of HI than Mexican background. The hearing testing procedures were similar between these studies. It is possible the different pattern by background reflects temporal changes as the children with Puerto Rican background in this early study had worse hearing than Mexican American children; those children would now be middle-aged adults.[37] Alternatively, sample differences may account for this difference as the typical male excess of hearing impairment was not seen among participants with Puerto Rican backgrounds in the HHANES, suggesting that participation or selection bias in HHANES may have led to underestimating the prevalence of HI in this group.[1] Results from the NHANES have suggested that Hispanics/Latinos have lower rates of hearing impairment than NHW.[3,38] However, in that study Hispanics/Latinos were primarily from Mexican backgrounds, which

may have led to over-estimating the ethnic differences in HI. Clearly, it is important for future studies to include people from diverse backgrounds to accurately determine the public health burden of hearing impairment.

Hearing impairment is associated with lower overall quality of life, and has been associated with depression and risk of dementia.[14–24] It is common for hearing impairment to go undetected and untreated for many years.[25–27] In this cohort, some of the participants with hearing impairment had conductive components which may be amenable to medical treatment. Health professionals and the public need to be aware that hearing impairment is a common and important health disorder affecting Hispanics/Latinos in the U.S. It is important to develop culturally appropriate effective intervention strategies to meet the communication needs of the Hispanic/Latino community.

Education and higher income have been associated with lower rates of hearing impairment in other cross-sectional studies and in longitudinal studies of NHW participants.[3,6,9,10,12] Similarly, in the HCHS/SOL cohort, people with higher educational levels and higher incomes were less likely to have HI than others. Socioeconomic factors are often associated with disease prevalence, including risk of cardiovascular disease and other age-related conditions, and occupational noise exposure which is a well-recognized risk factor for hearing loss. In this study, histories of noise exposure at work and outside of work (firearms and leisure sources) were associated with higher prevalence of HI. This finding is consistent with other cross-sectional studies of hearing.[3,5–7,38] The education/income gradient remained in the multivariable model adjusting for noise exposure suggesting that unidentified factors which vary by socioeconomic status factors may contribute to the loss of hearing with aging.

Cardiovascular disease and its risk factors have often been thought to contribute to aging changes in hearing, at least partially through its effects on the stria vascularis which is important for maintaining normal signal transduction in the inner ear.[40–42] Vascular factors also may damage central signal processing and contribute to deterioration in hearing with aging.[39] The higher prevalence of HI among HCHS/SOL participants with Puerto Rican background is consistent with a vascular hypothesis as they also were more likely than other groups to have multiple cardiovascular disease risk factors.[30] In this study, smoking, obesity, history of CVD, and diabetes also were associated with HI in simpler models adjusting for demographic factors; only diabetes and pre-diabetes remained significantly associated with HI in the final multivariable model. These findings are consistent with other studies.[3,6,7,8,9,11,12, 39,40] Diabetes is associated with generalized inflammation, basement membrane thickening, vascular disease and neural changes all of which also may damage the auditory system and result in HI. However, to date, diabetes has not been associated with the incidence of hearing impairment in large longitudinal studies, so the etiologic significance of this association remains uncertain. Inflammatory markers have been associated with HI in other studies. [43–44]

The strengths of the study are the population-based sampling strategy, large numbers of Hispanics/Latinos from diverse backgrounds and use of standardized, sensitive assessments of hearing and diabetes, as well as the availability of extensive lifestyle and health data.

There are, of course, limitations in drawing causal inferences due to the cross-sectional design. The smaller numbers of participants within some of the background groups may have resulted in lower power to detect differences. In addition, participants are representative of the four communities in United States included in the study but may not be representative of residents in other parts of the United States or of the countries from which they or their ancestors emigrated. The groups reporting Central or South American backgrounds are likely to be very heterogeneous because of the large number of countries and geographic regions encompassed. Measures of auditory function were limited as time constraints in this study of numerous health outcomes did not permit the inclusion of tests of speech understanding or central auditory processing. Self-reports of health conditions, noise exposure, and smoking, etc. may be subject to recall or reporting bias which may have led to under- or over-estimates of effect sizes. Nonetheless, this is the largest study of hearing sensitivity among people of diverse Hispanic/Latino backgrounds in the United States and suggests that the prevalence of hearing impairment varies within the U.S. Hispanic/Latino population in these communities.

Conclusion

This large multicenter study has demonstrated that HI is common among Hispanic/Latino adults from all backgrounds, as 15% of all adults had HI. Diabetes, less education, lower income, and more noise exposure were associated with higher odds of hearing impairments. Health care professionals need to be aware that Hispanic/Latino patients, especially those with abnormal glucose metabolism, may have hearing impairments and need screening and appropriate referrals. Future longitudinal studies of Hispanics/Latinos from diverse backgrounds could strengthen the determination of the risks associated with hearing loss. This longitudinal information is needed to identify modifiable risk factors to slow the progression of hearing loss with aging and to develop culturally appropriate effective intervention strategies to meet the communication needs of the Hispanic/Latino community.

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Table 1

Demographic Characteristics (unweighted and weighted for sampling design)

	Unweighted		Weighted	
	N	%	Mean or PCT	SE
Age				
18–24 years	1590	10.12	16.81	0.56
25–34 years	1969	12.53	21.50	0.61
35–44 years	2829	18.00	21.20	0.57
45–54 years	4729	30.09	19.00	0.48
55–64 years	3336	21.23	12.97	0.41
65+ years	1263	8.04	8.53	0.38
Gender				
Female	9415	59.91	52.03	0.57
Male	6301	40.09	47.97	0.57
Hispanic/Latino Background				
Central American	1674	10.65	7.39	0.55
Cuban	2301	14.64	20.51	1.72
Dominican	1340	8.53	9.48	0.71
Mexican	6354	40.43	38.21	1.68
Puerto Rican	2525	16.07	15.37	0.77
South American	1030	6.55	4.88	0.31
Other or Mixed	492	3.13	4.16	0.29
Center				
Bronx	3690	23.48		
Chicago	3985	25.36		
Miami	3996	25.43		
San Diego	4045	25.74		
Education				
No High school diploma or GED			32.37	0.73
At least High school diploma or GED			67.63	0.73

Table 2

Prevalence of Hearing Impairment by Hispanic/Latino Background (weighted for sampling design)

		Central American		Cuban		Dominican		Mexican		Puerto Rican		South American		Other/Mixed		All	
		Hearing Impairment (Worse ear)															
		%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Gender	Age (yrs)																
Males	18–44	5.05	1.16	6.46	1.22	6.32	1.99	4.33	0.74	7.14	1.34	2.68	1.15	3.25	1.48	5.20	0.49
	45+	37.65	3.72	39.71	2.32	29.35	3.58	33.39	2.14	41.20	3.50	33.44	4.13	34.42	6.99	36.76	1.25
Females	18–44	3.63	0.91	4.73	1.00	7.12	2.96	4.13	0.78	8.14	1.62	2.72	1.03	3.15	1.42	4.89	0.59
	45+	22.05	2.29	26.59	1.99	23.62	2.54	17.89	1.41	31.36	2.76	23.49	3.42	32.11	12.17	23.97	1.06
All		12.88	1.02	20.65	1.08	14.11	1.47	10.94	0.64	21.25	1.32	13.81	1.58	10.06	2.28	15.06	0.44
		Bilateral Hearing Impairment															
		%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Males	18–44	3.10	1.04	2.45	0.79	0.55	0.40	1.33	0.40	3.19	0.94	0.16	0.16	0.25	0.25	1.77	0.29
	45+	24.99	3.27	25.68	2.05	15.8	2.91	21.76	1.78	26.77	3.61	14.78	3.26	20.47	5.72	23.22	1.17
Females	18–44	2.17	0.71	0.62	0.35	1.37	0.66	1.71	0.61	4.60	1.35	0.28	0.28	0.79	0.57	1.78	0.34
	45+	9.00	1.55	15.40	1.67	14.22	2.51	10.29	1.11	16.60	2.03	14.28	2.73	8.97	3.40	13.18	0.74
All		7.16	0.77	11.94	0.90	6.23	0.75	6.06	0.46	12.25	1.15	6.64	1.04	3.67	0.82	8.24	0.33

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Table 3

Adjusted[1] Odds Ratios of Hearing Impairment by Demographic and Other Factors

	Hearing Impairment		Bilateral Hearing Impairment	
	OR	**95%CI**	**OR**	**95%CI**
Education				
No High school diploma or GED	1.0		1.0	
At least High school diploma or GED	0.71	0.61, 0.83	0.64	0.53, 0.77
Income				
Less than $10,000	1.0		1.0	
$10,001 – $20,000	0.88	0.70, 1.10	0.67	0.52, 0.87
$20,001 – $40,000	0.77	0.60, 1.00	0.55	0.42, 0.74
$40,001 – $75,000	0.53	0.40, 0.70	0.50	0.36, 0.69
More than $75,000	0.56	0.29, 0.73	0.29	0.16, 0.54
Diabetes				
No diabetes	1.0		1.0	
Pre-diabetes	1.14	0.95, 1.36	1.20	0.93, 1.56
Diabetes	1.50	1.24, 1.82	1.58	1.21, 2.08
Body Mass Index (Kg/m^2)				
Normal/Underweight (0–24.9)	1.0		1.0	
Overweight (25–29.9)	0.98	0.81, 1.18	1.01	0.80, 1.28
Obese (30+)	1.23	1.03, 1.48	1.28	1.00, 1.63
Smoking Status				
Never	1.0		1.0	
Former	1.09	0.93, 1.28	1.14	0.93, 1.41
Current	1.26	1.06, 1.50	1.33	1.06, 1.67
Alcohol Drinking Status				
Never	1.0		1.0	
Former	1.14	0.93, 1.39	1.17	0.89, 1.53
Current	0.87	0.72, 1.05	0.97	0.74, 1.26
History of CVD, Stroke, TIA				
No	1.0		1.0	
Yes	1.32	1.07, 1.62	1.06	0.84, 1.33
Hypertension				
No	1.0		1.0	
Yes	1.07	0.91, 1.26	1.08	0.89, 1.32
Longest Held Job Categories				
Professional/Managerial	1.0		1.0	
Service	1.30	1.04, 1.61	1.34	0.96, 1.86
Production/Manufacturing/Labor	1.18	0.96, 1.44	1.32	0.98, 1.78
History of Noise Exposure[2]				
No	1.0		1.0	
Yes	1.39	1.16, 1.66	1.31	1.05, 1.64

	Hearing Impairment		Bilateral Hearing Impairment	
	OR	**95%CI**	**OR**	**95%CI**
Occupational Noise Exposure				
Never	1.0		1.0	
Former	1.38	1.18, 1.60	1.41	1.16, 1.72
Current	1.16	0.95, 1.41	1.09	0.83, 1.45

[1] Adjusted for age, gender, center and Hispanic/Latino background.

[2] Defined as use of firearms, military service or exposure to loud noises during leisure time.

Table 4

Multivariate Adjusted Odds Ratios (OR) for Hearing Impairment

	Hearing Impairment		Bilateral Hearing Impairment	
	OR	**95% CI**	**OR**	**95% CI**
Age				
18–44 years	1.0		1.0	
45–64 years	4.84	3.83, 6.12	6.97	4.92, 9.89
65+years	18.52	12.40, 27.68	27.14	17.32, 42.52
Gender				
Female	1.0		1.0	
Male	1.66	1.33, 2.07	1.73	1.32, 2.25
Hispanic/Latino Background				
Dominican	1.42	0.84, 2.41	1.19	0.73, 1.94
Central American	1.02	0.70, 1.49	1.17	0.75, 1.81
Cuban	1.03	0.67, 1.57	0.92	0.57, 1.49
Mexican	1.0		1.0	
Puerto Rican	1.57	1.10, 2.25	1.38	0.94, 2.03
South American	1.01	0.68, 1.51	0.85	0.50, 1.44
Other or mixed	0.76	0.45, 1.29	0.69	0.38, 1.27
Education				
No High school diploma or GED	1.0		1.0	
At least High school diploma or GED	0.71	0.59, 0.86	0.63	0.50, 0.80
Income				
Less than $10,000	1.0		1.0	
$10,001 – $20,000	0.83	0.64, 1.07	0.62	0.47, 0.83
$20,001 – $40,000	0.74	0.56, 0.96	0.52	0.38, 0.71
$40,001 – $75,000	0.58	0.42, 0.80	0.59	0.39, 0.87
More than $75,000	0.58	0.36, 0.92	0.34	0.18, 0.64
Diabetes				
No diabetes	1.0		1.0	
Pre-diabetes	1.37	1.12, 1.67	1.44	1.07, 1.94
Diabetes	1.57	1.27, 1.94	1.61	1.22, 2.13
Body Mass Index (Kg/m^2)				
Normal/Underweight (0–24.9)	1.0		1.0	
Overweight (25–29.9)	1.24	0.98, 1.56	1.32	0.98, 1.79
Obese (30+)	1.18	0.94, 1.49	1.29	0.92, 1.80
Smoking Status				
Never	1.0		1.0	
Former	1.16	0.95, 1.40	1.13	0.90, 1.42
Current	1.19	0.97, 1.46	1.17	0.88, 1.56
Alcohol Drinking Status				
Never	1.0		1.0	

	Hearing Impairment		Bilateral Hearing Impairment	
	OR	**95% CI**	**OR**	**95% CI**
Former	1.21	0.94, 1.56	1.54	1.15, 2.06
Current	0.86	0.69, 1.08	1.17	0.86, 1.59
History of CVD, Stroke, TIA				
No	1.0		1.0	
Yes	1.11	0.88, 1.41	1.01	0.76, 1.34
Hypertension				
No	1.0		1.0	
Yes	1.15	0.94, 1.41	1.29	1.02, 1.62
Longest Held Job Categories				
Professional/Managerial	1.0		1.0	
Service Jobs	1.01	0.79, 1.29	1.02	0.70, 1.47
Production/Manufacturing/Labor	0.85	0.67, 1.08	0.89	0.63, 1.27
History of Noise Exposure[1]				
No	1.0		1.0	
Yes	1.35	1.07, 1.70	1.27	0.99, 1.63
Occupational Noise Exposure				
Never	1.0		1.0	
Former	1.27	1.03, 1.57	1.38	1.07, 1.79
Current	1.27	1.00, 1.63	1.23	0.92, 1.65

[1] Defined as use of firearms, military service or exposure to loud noises during leisure time.