Original Investigation

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

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IMPORTANCE Hearing impairment is common in adults, but few studies have addressed it in the US Hispanic/Latino population.

OBJECTIVE To determine the prevalence of hearing impairment among US Hispanic/Latino adults of diverse backgrounds and determine associations with potential risk factors.

DESIGN, SETTING, AND PARTICIPANTS The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) is a population-based sample of Hispanics/Latinos in four US communities (Bronx, New York; Chicago, Illinois; Miami, Florida; and San Diego, California). Examinations were conducted from 2008 through 2011. 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.

MAIN OUTCOMES AND MEASURES Hearing thresholds were measured by pure-tone audiometry. Hearing impairment was defined as a pure-tone average (PTA) of thresholds at 0.5, 1, 2, and 4 kHz greater than 25 dB hearing level. Bilateral hearing impairment required a PTA greater than 25 dB hearing level in both ears. Multivariable analyses included adjustments for sociodemographic and lifestyle variables, body mass index, and medical conditions.

RESULTS The prevalence of hearing impairment was 15.06% (SE, 0.44%) overall, and 8.24% (SE, 0.33%) had bilateral hearing impairment. The prevalence of hearing impairment was higher among people 45 years and older, ranging by Hispanic/Latino background from 29.35% to 41.20% among men and 17.89% to 32.11% among women. The multivariable-adjusted odds of hearing impairment was greater for participants of Puerto Rican background compared with Mexican background (odds ratio [OR], 1.57 [95% CI, 1.10-2.25]). The odds of hearing impairment were lower with more education (OR, 0.71 [95% CI, 0.59-0.86] for at least high school) and higher income (OR, 0.58 [95% CI, 0.36-0.92] for >$75 000 vs ≤$10 000). Noise exposure (OR, 1.35 [95% CI, 1.07-1.70]), diabetes (OR, 1.57 [95% CI, 1.27-1.94]), and prediabetes (OR, 1.37 [95% CI, 1.12-1.67]) were associated with hearing impairment.

CONCLUSIONS AND RELEVANCE Hearing impairment 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 whether these factors are involved in the etiology of hearing impairment and to identify ways to prevent or delay age-related changes in hearing.

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Hearing impairment 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 hearing impairment among men aged 55 to 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 hearing impairment, respectively.[1] More recently, reports from the National Health and Nutrition Examination Survey (NHANES) have suggested that hearing impairment is less common among Mexican Americans than among non-Hispanic whites (NHWs) but did not provide data about individuals from other Hispanic/Latino backgrounds.[2] Other large US 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 hearing impairment among Hispanic/Latino populations.

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

Methods

The Hispanic Community Health Study/Study of Latinos (HCHS/SOL) is a population-based cohort study of Hispanics/Latinos in 4 US cities (Bronx, New York; Chicago, Illinois; Miami, Florida; San Diego, California) that 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 = 1730), Cuban (n = 2348), Dominican (n = 1460), Mexican (n = 6471), Puerto Rican (n = 2728), and South American (n = 1068). 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 preva-

lence 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 US 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 Epi-Sense Audiometry Reading Center at the University of Wisconsin. Ambient sound levels were measured daily at each test site.[31] GSI 61 clinical audiometers (Grason-Stadler, Inc) equipped with TDH-50P and insert earphones (E-A-Rtone 3A, Cabot Safety Corp) were calibrated annually according to American National Standards Institute standards.[32] A brief otoscopic examination and screening tympanogram (Earscan, Micro Audiometrics) 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, and 4 kHz greater than 25 dB hearing level in either ear. A second definition of PTA greater than 25 dB hearing level in the better ear was also used to capture bilateral hearing impairment. This 4-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, 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 use of firearms, military service, or exposure to loud noises during leisure time. Occupational noise exposure was defined as a current or former job that was noisy (had to speak in a raised voice or louder to be heard 2 feet [61 cm] away). The longest held job was categorized as professional/managerial/technical, service, or production/manufacturing/labor.

Hypertension was defined as a systolic blood pressure of 140 mm Hg or greater, diastolic blood pressure of 90 mm Hg or greater, or receipt of antihypertensive medication.[30,35] Diabetes mellitus was defined as a fasting plasma glucose level of 126 mg/dL or greater (to convert to millimoles per liter, multiply by 0.0555), 2-hour postload plasma glucose level of 200 mg/dL or greater, a hemoglobin A_{1c} of 6.5% or greater, self-report of doctor-diagnosed diabetes (excluding gestational dia-

betes), or use of antihyperglycemic medications.[30,36] Prediabetes was defined as a fasting plasma glucose level between 100 and 125 mg/dL, 2-hour postload plasma glucose level between 140 and 199 mg/dL, or a hemoglobin A_{1c} level between 5.7% and 6.4%. Height was measured to the nearest centimeter and weight to the nearest 0.1 kg. Body mass index 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 4 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 hearing impairment. 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 to 44 years and 45 years and older to ensure good precision of prevalence estimates; the cut point reflects the original study design, which oversampled the 45 years and older age group. All analyses were performed using SAS, version 9.3 (SAS Institute), and SUDAAN, release 10.0.0 (RTI).

Results

The descriptive characteristics of the study participants (unweighted) and the sample population (weighted) are given in **Table 1**. In the weighted sample, 52.03% were female and 40.50% were 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% (SE, 0.44%) had hearing impairment, and approximately 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 because 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 aged 18 to 44 years, the prevalence of hearing impairment in either ear ranged from 2.68% (SE, 1.15%) among men reporting South American background to 7.14% (SE, 1.34%) among men of Puerto Rican background (Table 2). Similarly, among men 45 years or older, the prevalence of hearing impairment (in either ear) was highest among men reporting Puerto Rican background (41.20% [SE, 3.50%]) and varied among the other groups, with a low of 29.35% (SE, 3.58%) among men with Dominican background.

The prevalence of hearing impairment also varied among women by Hispanic/Latino background (Table 2). For women

Table 1. Demographic Characteristics (Unweighted and Weighted for Sampling Design)

	Unweighted, No. (%)	Weighted, % (SE)
Age, y		
18-24	1590 (10.12)	16.81 (0.56)
25-34	1969 (12.53)	21.50 (0.61)
35-44	2829 (18.00)	21.20 (0.57)
45-54	4729 (30.09)	19.00 (0.48)
55-64	3336 (21.23)	12.97 (0.41)
≥65	1263 (8.04)	8.53 (0.38)
Sex		
Male	6301 (40.09)	47.97 (0.57)
Female	9415 (59.91)	52.03 (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)

Abbreviations: ellipses, not shown; GED, General Educational Development.

aged 18 to 44 years, the prevalence ranged from a high of 8.14% (SE, 1.62%) among participants reporting Puerto Rican background to a low of 2.72% (SE, 1.03%) among those reporting South American background. Older women (45 years and older) who reported mixed or other background had a prevalence of 32.11% (SE, 12.17%) and the lowest prevalence was among the women of Mexican background (17.89% [SE, 1.41%]). 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 those of South American background.

Adjusting for age, sex, 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 hearing impairment (for a high school diploma or equivalent vs none, OR, 0.71 [95% CI, 0.61-0.83]). Those with the highest income level were significantly less likely to have hearing impairment 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 hearing impairment. Obesity, current smoking, history of CVD, service sector occupations, former exposure to occupational noise, and noise exposure history were associated with greater

Table 2. Prevalence of Hearing Impairment by Hispanic/Latino Background[a]

Sex	Age, y	% (SE) Central American	Cuban	Dominican	Mexican	Puerto Rican	South American	Other/Mixed	All
Hearing Impairment (Worse Ear)									
Male	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)
Female	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									
Male	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)
Female	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)

[a] Weighted for sampling design.

odds of hearing impairment (Table 3). Associations with bilateral hearing impairment were similar (Table 3).

In the multivariable-adjusted model (**Table 4**), age was strongly associated with hearing impairment; people 65 years of age or older had an 18.52-fold (95% CI, 12.40-27.68) greater prevalence of hearing impairment compared with younger adults (18-44 years). Greater education and higher income remained protective, with effect sizes similar to those in the simpler models. Compared with Mexican background, Puerto Rican background remained associated with increased odds of hearing impairment (OR, 1.57 [95% CI, 1.10-2.25]); there were no other Hispanic/Latino background groups with higher or lower odds of hearing impairment. Exposure to noise from firearms and leisure activities and former exposure to occupational noise were associated with increased odds of hearing impairment. Having diabetes or prediabetes was associated with significantly increased odds of hearing impairment. History of CVD, hypertension, body mass index, smoking, and alcohol were retained in the model, although not significantly associated with hearing impairment. 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 impairment.

Discussion

In this study of US Hispanics/Latinos from diverse backgrounds, hearing impairment 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 hearing impairment than women. Unlike in the early HHANES[1] in the 1980s, Puerto Rican background was associated with higher prevalence of hearing impairment than Mexican background. The hearing testing procedures were similar between these studies. It is possible that the different pattern by background reflects temporal changes because 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 because 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 the HHANES may have led to underestimation of the prevalence of hearing impairment in this group.[1] Results from the NHANES have suggested that Hispanics/Latinos have lower rates of hearing impairment than NHWs.[3,38] However, in that study Hispanics/Latinos were primarily from Mexican backgrounds, which may have led to overestimating the ethnic differences in hearing impairment. 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 that may be amenable to medical treatment. Health care professionals and the public need to be aware that hearing impairment is a common and important disorder affecting Hispanics/Latinos in the United States. 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 hearing impairment than others. Socioeconomic factors are often associated with disease prevalence, including risk of CVD 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 work

Table 3. Adjusted[a] Odds Ratios (ORs) of Hearing Impairment by Demographic and Other Factors

Characteristic	OR (95% CI)	
	Hearing Impairment	Bilateral Hearing Impairment
Education		
No high school diploma or GED	1 [Reference]	1 [Reference]
At least high school diploma or GED	0.71 (0.61-0.83)	0.64 (0.53-0.77)
Income, $		
≤10 000	1 [Reference]	1 [Reference]
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)
>75 000	0.56 (0.29-0.73)	0.29 (0.16-0.54)
Diabetes mellitus		
No diabetes	1 [Reference]	1 [Reference]
Prediabetes	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)
BMI		
0-24.9	1 [Reference]	1 [Reference]
25.0-29.9	0.98 (0.81-1.18)	1.01 (0.80-1.28)
≥30.0	1.23 (1.03-1.48)	1.28 (1.00-1.63)
Smoking status		
Never	1 [Reference]	1 [Reference]
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 [Reference]	1 [Reference]
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 cardiovascular disease, stroke, or transient ischemic attack		
No	1 [Reference]	1 [Reference]
Yes	1.32 (1.07-1.62)	1.06 (0.84-1.33)
Hypertension		
No	1 [Reference]	1 [Reference]
Yes	1.07 (0.91-1.26)	1.08 (0.89-1.32)
Longest held job categories		
Professional/managerial	1 [Reference]	1 [Reference]
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[b]		
No	1 [Reference]	1 [Reference]
Yes	1.39 (1.16-1.66)	1.31 (1.05-1.64)
Occupational noise exposure		
Never	1 [Reference]	1 [Reference]
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)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); GED, General Educational Development.

[a] Adjusted for age, sex, center, and Hispanic/Latino background.

[b] 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

Characteristic	OR (95% CI)	
	Hearing Impairment	Bilateral Hearing Impairment
Age, y		
18-44	1 [Reference]	1 [Reference]
45-64	4.84 (3.83-6.12)	6.97 (4.92-9.89)
≥65	18.52 (12.40-27.68)	27.14 (17.32-42.52)
Sex		
Female	1 [Reference]	1 [Reference]
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 [Reference]	1 [Reference]
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 [Reference]	1 [Reference]
At least high school diploma or GED	0.71 (0.59-0.86)	0.63 (0.50-0.80)
Income, $		
≤10 000	1 [Reference]	1 [Reference]
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)
>75 000	0.58 (0.36-0.92)	0.34 (0.18-0.64)
Diabetes mellitus		
No diabetes	1 [Reference]	1 [Reference]
Prediabetes	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)
BMI		
0-24.9	1 [Reference]	1 [Reference]
25.0-29.9	1.24 (0.98-1.56)	1.32 (0.98-1.79)
≥30.0	1.18 (0.94-1.49)	1.29 (0.92-1.80)
Smoking status		
Never	1 [Reference]	1 [Reference]
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 [Reference]	1 [Reference]
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 cardiovascular disease, stroke, or transient ischemic attack		
No	1 [Reference]	1 [Reference]
Yes	1.11 (0.88-1.41)	1.01 (0.76-1.34)
Hypertension		
No	1 [Reference]	1 [Reference]
Yes	1.15 (0.94-1.41)	1.29 (1.02-1.62)
Longest held job categories		
Professional/managerial	1 [Reference]	1 [Reference]
Service	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)

(continued)

Table 4. Multivariate Adjusted Odds Ratios (OR) for Hearing Impairment (continued)

	OR (95% CI)	
Characteristic	Hearing Impairment	Bilateral Hearing Impairment
History of noise exposure[a]		
No	1 [Reference]	1 [Reference]
Yes	1.35 (1.07-1.70)	1.27 (0.99-1.63)
Occupational noise exposure		
Never	1 [Reference]	1 [Reference]
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)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); GED, General Educational Development.

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

(firearms and leisure sources) were associated with higher prevalence of hearing impairment. This finding is consistent with other cross-sectional studies of hearing.[3,5-7,38] The education and income gradients remained in the multivariable model adjusting for noise exposure, suggesting that unidentified factors that vary by socioeconomic status 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 the effects of CVD on the stria vascularis, which is important for maintaining normal signal transduction in the inner ear.[39-42] Vascular factors also may damage central signal processing and contribute to deterioration in hearing with aging.[39] The higher prevalence of hearing impairment among HCHS/SOL participants with Puerto Rican background is consistent with a vascular hypothesis because they also were more likely than other groups to have multiple CVD risk factors.[30] In this study, smoking, obesity, history of CVD, and diabetes also were associated with hearing impairment in simpler models adjusting for demographic factors; only diabetes and prediabetes remained significantly associated with hearing impairment in the final multivariable model. These findings are consistent with other studies.[3,6-9,11,12,39,40] 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 hearing impairment. 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 hearing impairment 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 because of 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 4 communities in the 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 heterogeneous because of the large number of countries and geographic regions encompassed. Measures of auditory function were limited because 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 such factors as health conditions, noise exposure, and smoking may be subject to recall or reporting bias, which may have led to underestimates or overestimates of effect sizes. Nonetheless, to our knowledge, 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 US Hispanic/Latino population in these communities.

Conclusions

This large multicenter study has demonstrated that hearing impairment is common among Hispanic/Latino adults from all backgrounds because 15% of all adults had hearing impairment. Diabetes, less education, lower income, and noise exposure were associated with higher odds of hearing impairment. Health care professionals need to be aware that Hispanic/Latino patients, especially those with abnormal glucose metabolism, may have hearing impairment 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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