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Hearing Aid Use among Older United States Adults: The National Health and Nutrition Examination Survey, 2005–2006 and 2009–2010

Kathleen E. Bainbridge, PhD, M.P.H[1] and **Virginia Ramachandran, AuD, PhD**[2]

[1]National Institute on Deafness and Other Communication Disorders, National Institutes of Health, Bethesda, MD

[2]Henry Ford Hospital, Department of Otolaryngology – Head and Neck Surgery, Detroit, MI

Abstract

Objective—We estimated the proportion of older United States adults who report hearing aid use among those likely to benefit. In order to more fully understand what factors underlie the low proportion of hearing aid use, we examined a variety of socio-demographic correlates as well as measures of health care access and insurance status in relation to hearing aid use among potential hearing aid candidates.

Design—The study makes use of cross-sectional data collected from 2005–2006 and 2009–2010 as part of the National Health and Nutrition Examination Survey. The 1,636 adults aged 70 years and older were selected using a complex sampling design and comprise a nationally representative sample. In addition to self-reported hearing aid use, data on pure-tone thresholds, perceived hearing ability, place for routine health care, time since last hearing test, type of insurance coverage, and sociodemographic characteristics including age, gender, race/ethnicity, family size, and income-to-poverty ratio were collected. The analytical sample consisted of 601 adults who had a better-ear pure-tone average of ≥35 dB HL at 500, 1000, and 2000 Hz or who reported moderate or worse hearing ability.

Results—One-third of the potential hearing aid candidates reported current use of hearing aids. We observed a 28 to 66% greater prevalence of hearing aid use among older adults in the upper four-fifths of the income-to-poverty distribution compared to those in the bottom one-fifth. Compared to people who had their hearing tested 5–9 years ago, those with more recent hearing tests were more than 2–3 times as likely to be a current hearing aid user. No differences were observed by age after adjusting for pure-tone average and no differences were observed by gender after adjusting for perceived hearing ability. No differences were observed by place of routine health care or by type of insurance coverage.

Corresponding author: Kathleen E. Bainbridge, National Institute on Deafness and Other Communication Disorders, Executive Plaza South, Suite 400A, 6120 Executive Blvd, MSC 7180, Bethesda, MD20892-7180, Phone: (301) 435-1350, Fax: (301) 402-0390, bainbridgek@mail.nih.gov.

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Conclusions—Use of hearing aids is low among older adults who might benefit. Identifying and surmounting barriers to hearing aid use, especially among low income adults, remains an important objective for hearing health care in the United States.

Keywords

hearing loss; hearing aids; income; socioeconomic factors

Introduction

Hearing loss is a common condition among older adults, with United States prevalence estimates in the range of 45–63% for bilateral deficit among those age 70 years and older (F. R. Lin, Thorpe, Gordon-Salant, & Ferrucci, 2011). Over 2.8 million diagnoses of sensorineural hearing loss occurred during outpatient visits from 2005–2007 in patients aged 65 years and older (H. W. Lin & Bhattacharyya, 2011). The consequences of untreated hearing loss vary depending on the degree, type, and configuration of loss and whether or not the individual experiences communication difficulty (Dalton et al., 2003; Hogan, O'Loughlin, Miller, & Kendig, 2009), but may include lower quality of life, reduced cognitive function, and lost productivity in the workplace (Dalton et al., 2003; F. R. Lin, 2011; Mohr et al., 2000). Despite these consequences, the proportion of people who use hearing aids as a means to help treat hearing loss is low. Previous national estimates suggest that about 59% of people aged 70 years and older with moderate to severe hearing loss do not use hearing aids (F. R. Lin et al., 2011). Increasing the use of hearing aids among older adults is a current federal public health objective (http://healthypeople.gov/2020/topicsobjectives2020/default.aspx).

Hearing aid use results from a process in which an individual seeks help for hearing problems, purchases hearing aids, and finally, determines that their use is beneficial (Knudsen, Oberg, Nielsen, Naylor, & Kramer, 2010; Meyer & Hickson, 2012). Use of hearing aids has been shown to vary with age, the degree of hearing loss, and self-reported hearing ability, although these factors may be operating through their effect on help seeking behavior or hearing aid uptake (Meyer & Hickson, 2012; Popelka & Cruickshanks, 1998). Socio-demographic factors in the United States such as gender, race, marital status or whether one lives alone have not been consistently associated with hearing aid use (Meyer & Hickson, 2012; Popelka & Cruickshanks, 1998; Tomita, Mann, & Welch, 2001). Investigations of individual-level socio-economic factors in the United States have found educational attainment to be associated with hearing aid use (F. R. Lin et al., 2011; Popelka & Cruickshanks, 1998). Although market-based surveys of attitudes toward amplification suggest that affordability is an important barrier to hearing aid adoption, population-based studies that have examined income as a determinant of hearing aid acquisition or use have failed to demonstrate an association (Fischer et al., 2011; F. R. Lin et al., 2011; Popelka & Cruickshanks, 1998).

The low prevalence of hearing aid use in the United States may also be a reflection of inadequate access to hearing specialists. Access to audiology services may in turn depend on access to and utilization of general health care. Prelingually and postlingually deafened

adults differ in their utilization of health care from hearing adults (Barnett & Franks, 2002), but whether health care utilization is lower among adults with less severe hearing loss is unknown. Third-party coverage for hearing aids is largely absent in the United States, but hearing aid uptake may vary by type of insurance coverage due to the existence of some state Medicaid plans and the coverage of rehabilitation services for military veterans.

The aims of this cross-sectional study were to 1) estimate the proportion of potential hearing aid candidates who report their use and 2) determine whether hearing aid use varied by socio-demographic factors, health care utilization, and type of health insurance provider in a nationally representative sample of adults aged 70 years and older.

Methods

Study population

Data were collected in 2005–2006 and 2009–2010 as part of the National Health and Nutrition Examination Survey (NHANES) conducted by the National Center for Health Statistics (NCHS). Data from these two time points were combined to provide more precise estimates due to greater statistical power. The survey used a stratified, multistage, probability cluster design that resulted in a nationally representative sample of the non-institutionalized, civilian United States population. Study participants were interviewed in their home and underwent an audiometric examination at a mobile examination center. Low-income individuals were among those over-sampled, allowing for more precise estimates of the association between income and hearing aid use among the low-income population. Valid data were available for 1,636 adults aged 70 years and older.

Measures

Audiometric thresholds, hearing ability, and hearing aid use—Pure-tone air-conduction audiometric thresholds in decibels hearing level (dB HL) were obtained for each ear at 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz by trained technicians with a calibrated Interacoustics Model AD226 audiometer. Data collection occurred with participants in a sound-treated booth, which met the American National Standard Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms (*ANSI S3.1-1999 (R 2003)*). Daily confirmation was made of the audiometer calibration using a Quest Model BA-201-25 bioacoustic simulator. For the 1,636 adults with valid audiometric data, we computed the pure-tone average (PTA) in each ear of thresholds measured at 500, 1000, and 2000 Hz, because the majority of the speech spectrum occurs within this range (Katz, 2002). Self-reported hearing ability was obtained by asking participants to rate their hearing without a hearing aid on a six-item scale: a) excellent, b) good, c) have a little trouble, d) have moderate trouble, e) have a lot of trouble, or f) deaf. The frequency distribution of better-ear PTA by self-reported hearing ability is presented in Table 1. Because the focus of our research question was identifying determinants of hearing aid use, we sought to identify a subset of study participants who would most likely benefit from hearing aids derived from degree of hearing loss and self-reported ability (Hogan et al., 2009). There are no established criteria to determine who would most likely benefit from hearing aids. We limited the analysis to 601 persons whom we classified as hearing aid candidates based on a better-ear

PTA ≥35 dB HL, a level for which intervention is likely to be beneficial, (Davis, Smith, Ferguson, Stephens, & Gianopoulos, 2007)or a report of moderate trouble hearing, a lot of trouble hearing, or being deaf. The shaded portion of Table 1 illustrates the subset of 601 hearing aid candidates among the analytical sample. Hearing aid users were classified on the basis of a positive response to the question "In the past 12 months, have you worn a hearing aid at least 5 hours a week?"

Sociodemographic characteristics—Income-to-poverty ratio is a measure that expresses family income as a function of poverty thresholds established by the U.S. Census Bureau for the purpose of defining poverty. Poverty thresholds vary by family size and composition (number of adults and number of children). We categorized participants by income-to-poverty ratio quintile using cut points of 1.32, 2.02, 2.80, and 4.37, representing the 20^{th}, 40^{th}, 60^{th} and 80^{th} percentiles of the income-to-poverty-ratio distribution. A person with an income-to-poverty-ratio level at one of these cutpoints belongs to a family with an income that is 32% above the poverty threshold, 2.02 times, 2.8 times, and 4.37 times the designated poverty threshold, respectively. Other socio-demographic information collected during the interview included age, gender, race/ethnicity, and marital status. Educational attainment was categorized as less than high school, high school, and more than high school. Family size was categorized as 1, 2, or 3 or more members with the definition of family being limited to related people who reside together. For the 2005–2006 data collection, available financial support was assessed with a question asking whether a respondent could count on anyone for extra financial help with paying bills, housing costs or hospital visits.

Health care utilization and health insurance provider—Participants who reported having a place for routine health care were asked whether the place is a) a clinic or health center, b) a doctor's office or HMO, c) a hospital emergency room, d) a hospital outpatient department, or e) some other place. Participants reported the number of health care interactions (excluding hospitalizations) in the previous year and the last time they had their hearing tested. Health insurance status was obtained by asking whether the respondent was covered by health insurance or a health care plan and whether any health insurance included private insurance, Medicare, or other public insurance such as Medicaid, a state health plan, or veteran's benefits. From the information provided, we classified participants as being covered by Medicare only, Medicare and private insurance, Medicare and other public insurance, or private insurance only.

Statistical Analysis

The weighted proportion and 95% confidence limits of hearing aid use among hearing aid candidates was computed overall and stratified by five-year age groups, gender, race/ethnicity, marital status, educational attainment, family size, income-to-poverty-ratio quintile, and available financial support. The weighted proportion of hearing aid users was also estimated by category of health care utilization measures and health insurance provider. Significance testing of the unadjusted proportions was performed with Chi-square tests for general association with level of significance set at a=0.05. Age-adjusted proportions and 95% confidence limits were computed as the average marginal prediction from logistic regression models for each potential covariate adjusted for age, but are not presented in the

results, because the estimates were not markedly different after adjusting for age. Factors independently associated with hearing aid use were identified using the most parsimonious multiple logistic regression models controlling for better-ear PTA and self-reported hearing ability. Because odds ratios are poor estimates of prevalence ratios for outcomes which are not rare, such as hearing aid use, adjusted prevalence ratios and 95% confidence limits were computed as the average marginal prediction for each income-to-poverty quintile and for each category of time since last hearing test and are directly standardized for better-ear PTA and self-reported hearing ability. Analyses were performed using SAS version 9.2 (SAS Institute, Inc, Cary, NC) and SUDAAN version 10.0.1 (Research Triangle Institute, Research Triangle Park, NC) incorporating 4-year sample weights.

Results

The frequency distribution of better-ear PTA by self-reported hearing ability is presented in Table 1. Sizeable proportions of people report levels of hearing ability that would not be predicted based on their PTA alone. Among those reporting good or excellent hearing, 8.3% had a better-ear PTA at least 35 dB HL indicating they might benefit from hearing aid use due to being unable to perceive certain sounds at conversational intensity levels. Among those reporting a little trouble hearing, 29.0% had a better-ear PTA meeting this threshold. On the other hand, for those reporting moderate trouble and those reporting a lot of trouble or being deaf, 43.7% and 15.7%, respectively, had a PTA less than 35 dB HL demonstrating that there are factors other than hearing sensitivity loss (as measured by PTA) that impact one's perception of hearing ability.

Among the adults we identified as potential hearing aid candidates, the proportion who reported using hearing aids was 33.1% (95% CI 29.9, 36.5). The frequency distributions of socio-demographic characteristics and proportion of hearing aid users among the 601 candidates are presented in Table 2. Less than a quarter of candidates aged 70–74 years reported hearing aid use. Among those 75–79 years of age, 41% reported hearing aid use and about one third of those 80 years or greater used hearing aids ($p<0.05$, for general association). Thirty-eight percent of males reported hearing aid use compared to 28.3% of females ($p<0.05$). The proportion of hearing aid use among non-Hispanic white people was over twice that of non-Hispanic black, Hispanic, or other (including multiracial) people (35.4% vs. 17.1%, ($p<0.05$)). There was no statistically significant association between marital status or family size and hearing aid use. Strong socio-economic patterning ($p<0.05$ for general associations) of hearing aid use is suggested by the increasing proportion of hearing aid use with increasing educational attainment, with increasing income-to-poverty ratio quintile, and with available financial support. Adjusting for age does not markedly alter the proportions (data not shown).

In Table 3, the frequency distributions of factors related to health care utilization and health insurance provider are shown. No differences in hearing aid use were detected by place of routine health care or number of health care visits in the previous year. In contrast, hearing aid use was strongly patterned by time since last hearing test with 67% of people who had been tested within the past year reporting hearing aid use compared to forty percent of people tested within 1–4 years and less than 10% of persons tested 5–9 years ago ($p<0.05$

for general associations). The age-adjusted proportions indicate these differences are not due to differences in the age distribution by time since last hearing test (data not shown). We observed no association between health insurance provider and hearing aid use among this segment of the population.

Table 4 displays the independent associations of income-to-poverty ratio quintile and time since last hearing test, adjusted for PTA in the better ear and self-reported hearing ability. The proportion of persons in the upper quintiles of the income-to-poverty distribution in the United States who use hearing aids is 28 to 66% greater than those in the lowest quintile [prevalence ratio (PR) range: (1.28 (1.00, 1.65) – 1.66(1.24, 2.21))]. Compared to people who had their hearing tested 5–9 years ago, people who had their hearing tested more recently were 2.4–3.7 times as likely to be a current hearing aid user [PR (2.38 (1.23, 4.58) for those tested 1–4 years ago and PR 3.69 (1.82, 7.48) for those tested <1 year ago]. People who report available financial support are 75% more likely to report hearing aid use PR=1.76 (0.97, 3.19) ($p<0.05$).

Discussion

Hearing aids can provide substantial benefits for hearing-related quality of life in older adults, (Yueh et al., 2001) yet we observed that only one-third of United States adults age 70 years and older who might benefit from their use report that they use them for at least five hours per week. In an effort to understand why this proportion remains so low**,** we examined correlates of hearing aid use among a set of socio-economic factors and measures of health care access and utilization among older adults with moderate hearing loss (better-ear PTA ≥ 35 dB HL) and who report hearing difficulty. Our evaluation of socioeconomic factors related to hearing aid use suggests that people in the upper four-fifths of income-to-poverty ratio were 28–66% more likely to report using hearing aids than those in the lowest one-fifth of the distribution. We demonstrated that individuals who have had their hearing tested within the last four years were 2.4–3.7 times more likely to report current hearing aid use.

The 33.1% of hearing aid candidates who report their use is lower than estimates previously reported in the peer-reviewed literature (F. R. Lin et al., 2011). These estimates are not directly comparable, because the earlier reports of hearing aid use were stratified by predetermined levels of hearing severity. Our aim was to estimate and identify correlates of hearing aid use among those people who would likely receive a recommendation for hearing aids had they been given the opportunity. In the current study, because the commonly-used three-frequency average correlates well with speech reception thresholds, we limited thresholds to 500, 1000, and 2000 Hz (Katz, 2002). We also added reported hearing ability as an inclusion criterion, because perception of hearing ability has been shown to be a strong predictor of hearing aid acquisition (Palmer, Solodar, Hurley, Byrne, & Williams, 2009).

In contrast to previous studies of determinants of hearing aid use in the United States (Fischer et al., 2011; F. R. Lin et al., 2011), we find family income to be positively associated with hearing aid use. One explanation for differing results across studies is that the greater precision with which we assessed income enabled better estimates of a previously unidentified association. Also for studies in which individuals were sampled

from smaller geographic areas, there is likely to be greater socio-economic homogeneity that limited the ability to disaggregate the association of hearing aid use with education from that with income.

Any person who obtains hearing aids must have a recent hearing test prior to hearing aid purchase and fitting. Thus, the observation that time since last hearing test was strongly correlated with hearing aid use is consistent with expectation. Compared to people who report their last hearing test was five to nine years ago, people who report being tested within the last one to four years were over twice as likely to use hearing aids and people reporting a hearing test within the last year were 3.7 times as likely to report using hearing aids. One likely explanation is that time since hearing assessment may be an indicator of perceived hearing aid need (Mulrow, Tuley, & Aguilar, 1992). We estimate that among these older adults who report at least a moderate degree of hearing difficulty, over 25% have not had a hearing test within the last 10 years. Identifying ways to provide hearing tests to this underserved segment of the population may be an important step in increasing hearing aid use among potential candidates.

We found no association of hearing aid use with either measure of general health care: place for routine health care or number of health care visits in the past year. Ninety-five percent of the adults in this older sample report Medicare as a provider of their health insurance. Given Medicare's non-reimbursement for hearing aids, we examined whether people carrying additional private or public health insurance coverage might be more apt to adopt hearing aids. We observed no differences, perhaps because we were not able to discern whether private insurance coverage included hearing healthcare benefits or whether people were residing in states where hearing aids are covered by Medicaid (Cohen-Mansfield & Taylor, 2004).

We observed age-specific differences in hearing aid use in unadjusted analyses that were eliminated after adjusting for age-related differences in pure-tone average, a finding that is consistent with the conclusions of a recent review (Knudsen et al., 2010). In contrast, the greater reported usage of hearing aids among males was unaffected when adjusting for pure-tone average, but was accounted for by gender differences in reported hearing difficulty. This effect may be explained by the different configuration of hearing loss with males having high-frequency "sloping" hearing loss compared to "flatter" losses that occur more frequently among females (Staehelin et al., 2011). This configuration of hearing loss reduces audibility of high-frequency consonant sounds that give meaning to speech, resulting in greater communication difficulty and possibly greater willingness to consider amplification. We found no effect of education on hearing aid use after adjusting for family income. This observation suggests that public health efforts to increase hearing aid use among people of lower socioeconomic status that do not address the issue of affordability may be ineffective.

Our findings should be viewed in light of limitations to this analysis. Our measure of hearing aid use includes anyone who reports a minimum of five hours of use per week. While this level of use might be considered sub-optimal, we have no expectation that any differential misclassification (i.e. classification of non-users as hearing aid users) occurred by income-to-poverty quintile. On the other hand, it is plausible that people with more

recent hearing aid tests are more likely to over-report hearing aid use if they purchased, but do not use, their hearing aids. This differential reporting could explain at least some of the associations we observe.

Our measure of income is one based on family and not necessarily the individual respondent's resources. A disadvantaged individual may be classified in a higher category of family income by virtue of living with family members. If this misclassification occurs more frequently among the non-adopters due to economic difficulties, the prevalence ratios we report are likely to be inflated relative to those that might have been estimated using individual income. When we adjust for available financial support, however, the greater likelihood of hearing aid use among those in higher income-to-poverty quintiles is preserved. Additional family resources are not sufficient to eliminate the disparity in hearing aid use by family income.

Because the survey data we analyzed are cross-sectional in nature, the temporal relationship between hearing aid use and family income is not established. While it is possible that non-adopters of hearing aids have lower income as a result of having left the workplace prematurely, the more probable explanation is that among adults in this age group, the majority of whom have age-related hearing loss that has likely worsened over time, those with lower incomes choose not to purchase hearing aids. The associations with income that we describe may reflect some residual confounding due to unmeasured factors such as hearing aid technology and actual costs of the device. Last, our sample is derived from non-institutionalized adults, so we are unable to generalize about the role of income or hearing health care access among persons in residential care facilities (Cohen-Mansfield & Taylor, 2004).

Although these data demonstrate that family-level financial means are associated with hearing aid use in the United States, hearing aid use is also low in countries where their cost is covered by public insurance (Barto et al., 2001). Data from the United Kingdom show that less than half of hearing aid candidates report owning hearing aids and 40% of hearing aid owners report that they did not regularly use their aids (Smeeth et al., 2002). Similarly, community-based data from Australia demonstrate that only one-third of women prescribed hearing aids reported use (Ward, Lord, Williams, & Anstey, 1993). There are clearly barriers to hearing aid use that exist even when financial factors are mitigated. Identification and understanding of non-financial barriers will also be necessary to promote optimal use of hearing aids.

In conclusion, we find one-third of hearing aid candidates aged 70 years and older report hearing aid use. These national data suggest low-income adults and those who have not been recently evaluated for hearing problems are less likely to report hearing aid use. If public health efforts to increase the opportunity for quality hearing health care in the general population incorporate the concerns of those having low income, the income disparity in hearing aid use may be reduced.

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Table 1

Frequency distribution of better ear pure tone average[†] by self-reported hearing ability (n=1636)

	Self-reported hearing ability							
	Excellent/good		Little trouble		Moderate trouble		Lot of trouble/deaf	
	n	%	n	%	n	%	n	%
Better-ear pure-tone average[†]								
<20 dB HL	417	53.1	111	26.7	22	9.3	7	3.3
≥20–34.9 dB HL	321	38.6	186	44.3	77	34.4	19	12.4
≥35–49.9 dB HL	68	7.9	110	24.7	96	43.0	46	27.2
≥50–64.9 dB HL	4	0.3	16	3.4	32	11.6	67	42.4
≥65–79.9 dB HL	0	0.0	4	0.8	5	1.5	19	12.7
≥ 80 dB HL	1	0.1	1	0.1	2	0.3	5	2.0
Total	811	100.0	428	100.0	234	100.0	163	100.0

[†]Pure-tone average of thresholds at 500, 1000, and 2000 Hz

Table 2

Proportion (95% Confidence Interval) of hearing aid users by socio-demographic characteristics among hearing aid candidates aged 70 years or greater - NHANES 2005–2006 and 2009–2010 (n=601).

	n	%	Proportion (95% CI)
Overall	601	100	33.1 (29.9, 36.5)
Age, years			
70–74	152	25.14	24.2 (17.9, 31.9)*
75–79	136	25.15	41.1 (32.8, 49.9)
≥80	313	49.71	33.6 (28.9, 38.6)
Gender			
Male	343	48.6	38.2 (32.8, 43.9)*
Female	258	51.4	28.3 (23.6, 33.5)
Race/ethnicity			
Non-Hispanic White	465	87.29	35.4 (31.9, 39.2)*
Non-Hispanic Black, Hispanic, other race, or multiracial	136	12.71	17.1 (10.0, 27.9)
Marital status‡			
Married/cohabitating	309	53.5	34.7 (29.5, 40.3)
Divorced/separated	44	6.2	17.5 (6.5, 39.1)
Widowed	228	40.3	32.2 (26.1, 38.9)
Educational attainment			
< High school	235	34.15	26.4 (22.4, 30.9)*
High school	149	26.57	31.1 (22.8, 40.8)
> High school	215	39.28	39.9 (33.0, 47.3)
Family Size			
1	206	34.77	32.0 (25.6, 39.3)
2	296	51.50	34.0 (29.2, 39.2)
3 or more	99	13.73	32.4 (22.2, 44.5)
Income-to-poverty ratio quintile			
0–1.32	154	21.77	21.7 (15.5, 29.4)*
>1.32–2.02	129	23.07	26.5 (18.2, 36.9)
>2.02–2.80	106	21.45	36.9 (25.3, 50.2)
>2.80–4.37	82	17.58	36.9 (25.4, 50.0)
>4.37	77	16.13	47.8 (35.2, 60.7)
Financial support§			
Available	180	73.0	40.9 (33.8, 48.6)*
Unavailable	67	27.0	14.5 (6.9, 28.1)

† 95% CI=95% confidence interval

‡ Excludes 20 persons who never married.

* p<0.05 chi square test for general association

[§]Data available for 2005–2006 only, n=247

Table 3

Proportion (95% Confidence Interval) of hearing aid users by measures of general and hearing health care utilization, and health insurance provider among hearing aid candidates aged 70 years or greater - NHANES 2005–2006 and 2009–2010 (n=601).

	n	%	Proportion (95% CI†)
Overall	601	100	33.1 (29.9, 36.5)
Place for routine health care			
Clinic or health center	100	16.10	35.1 (24.1, 48.0)
Doctor's Office or HMO	453	78.74	33.4 (29.0, 38.2)
Hospital emergency room or hospital outpatient department or some other place	34	5.17	28.9 (14.3, 49.7)
Health care visits in the previous year			
0–1	77	13.2	31.0 (23.1, 40.0)
2–3	160	27.1	33.2 (25.2, 42.3)
4–9	215	36.1	34.7 (28.4, 41.5)
≥ 10	146	23.5	32.5 (25.2, 40.7)
Years since last hearing test			
<1	155	26.7	67.0 (58.1, 74.9)*
1–4	208	35.7	40.0 (32.2, 48.3)
5–9	57	9.3	9.8 (3.8, 22.8)
≥ 10	90	15.1	3.1 (0.6, 15.2)
Never	84	13.1	0.0 (*,*)
Health insurance provider‡			
Medicare only	159	24.9	28.1 (21.3, 36.1)
Medicare and private insurance	304	56.2	36.2 (31.4, 41.2)
Medicare and other public insurance	90	13.4	33.0 (23.9, 43.6)
Private insurance only	29	5.4	36.1 (16.1, 62.6)

† 95% CI=95% confidence interval

* confidence interval undefined

‡ excludes 10 uninsured persons and 9 persons who don't report Medicare insurance

* p<0.05 chi square test for general association

Table 4

Multivariable-adjusted[†] prevalence ratios (95% confidence interval) for independent associations with hearing aid use, - NHANES 2005–2006 and 2009–2010 (n=468).

Characteristic	Prevalence Ratio (95% CI) (n=468)[*]	Prevalence Ratio (95% CI) (n=200)[‡]
Income to poverty level quintile		
1st	1.0	1.0
2nd	1.28 (1.00, 1.65)	1.52 (1.08, 2.14)
3rd	1.61 (1.19, 2.17)	1.66 (1.15, 2.40)
4th	1.45 (0.96, 2.18)	1.36 (0.72, 2.56)
5th	1.66 (1.24, 2.21)	1.56 (0.95, 2.57)
Time since last hearing test		
< 1 year ago	3.69 (1.82, 7.48)	3.94 (1.44, 10.79)
1–4 years ago	2.38 (1.23, 4.58)	2.52 (0.98, 6.46)
5–9 years ago	1.0	1.0
10+ years ago	0.51 (0.10, 2.50)	0.94 (0.16, 5.48)
Financial Support		
Available		1.76 (0.97, 3.19)
Unavailable		1.0

[†] Adjusted for better ear pure tone average and self-reported hearing ability

[*] Data collected in 2005–2006 and 2009–2010

[‡] Data collected in 2005–2006