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Self-Reported Hearing in the Last Two Years of Life Among Older Adults

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Abstract

Background—Epidemiologic data on the prevalence of hearing loss near death is lacking.

Objectives—To assess the prevalence and correlates of self-reported hearing loss during the last two years of life.

Design—Observational cohort study.

Setting—The Health and Retirement Study (HRS) is a longitudinal nationally representative cohort of adults age >50 (2000 to 2013).

Participants—Older adults

Measurements—The HRS interview closest to death was used (mean 12.2 months prior to death). Participants rated their hearing (excellent, very good, good, fair, or poor), and if they used hearing aids. We describe the prevalence and correlates of fair/poor ratings adjusted for age and gender.

Results—Of 5,895 participants (mean age at death 78 years, 53% women, 20% non-white), overall, 32% rated their hearing as fair/poor (95% Confidence Interval [CI] 31–34%), but 60% (95% CI 57–64%) of the 7% of participants that used hearing aids rated hearing as fair/poor. The prevalence of fair/poor hearing was highest among participants interviewed closest to death (29% 19–24 months prior to death, 36% 1–6 months prior to death, p for trend = 0.01). Correlates of

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fair/poor hearing during the last two years of life included: age at death (age 50–59 22%, 60–69 21%, 70–79 26%, 80–89 38%, 90 50%), gender (men 35%, women 30%), ethnicity (Latino 42%, white 33%), wealth (lowest quartile 38%, highest quartile 27%), history of heart disease (yes 38%, no 27%), dependence in activities of daily living (yes 42%, no 26%), difficulty taking medications (yes 46%, no 29%), and probable dementia (yes 44%, no cognitive impairment 24%).

Conclusion—Self-reported hearing loss increases during the last two years of life and is associated with physical and social vulnerability.

Keywords

Hearing Loss; End-of-life; Population-based studies

INTRODUCTION

Upwards of 30 million individuals in the United States aged 12 and over have documented hearing loss.¹ Prevalence increases significantly with age with some data reporting that 80% of persons over the age of 80 have hearing loss,^{2,3} yet only 20% of people older than 80 consider themselves hearing impaired.^{1,2,4–6} Hearing aids, while the gold standard treatment for hearing loss, are dramatically underutilized by older adults.^{5,7} Medicare is specifically barred from providing coverage for hearing aids.⁸

Age-related hearing loss adversely impacts quality of life and quality of communication, two factors considered vital to patients near the end of life.⁹ Hearing loss is associated with poorer ratings of patient-physician communication as well as poorer healthcare quality.¹⁰ The ability to hear near the end-of-life is important for communication about symptom assessment, establishing goals of care and treatment plans, and leave taking.¹¹ Even seemingly mundane conversations with a dying loved one can take on an added dimension of importance when time is limited.

Despite the potential importance of hearing loss near the end of life, no studies have assessed its prevalence during this time. To fill this gap in our knowledge, we conducted a study of the prevalence of self-rated hearing and reported hearing aid use among older adults in the last two years of life. Because the last years of an older adult's life are characterized by the accumulation of chronic conditions (e.g. heart failure), treatments (e.g. furosemide), and impairments in the ability to concentrate, each of which is associated with hearing loss, we hypothesized that the prevalence of hearing loss might be higher in older adults nearing death than in the general population of older adults. To inform the design and targeting of future interventions, we identified groups of patients with the highest prevalence of hearing loss during the last two years of life.

METHODS

Setting and Participants

The Health and Retirement Study (HRS) is a longitudinal survey of older adults. The HRS was created in 1992 and new cohorts of participants are added over time to ensure that it remains nationally representative of the US population over age 50. Participants are

interviewed every two years for life. If a participant is too ill or cognitively impaired to be interviewed, the interview is conducted with a proxy, generally the participant's next of kin. Detailed information on the design of the HRS is available.¹²

We identified 6,715 participants who died between Jan 1, 2000 and March 15, 2013 (the last interview data available). After excluding 820 participants who did not respond to questions about self-rated hearing and hearing aid use in the final interview before death, our final sample consisted of 5,895 participants. The mean time interval between the last interview and death was 12.2 months (SD 6.7).

Measures

Each participant was asked the yes/no question, "Do you ever wear a hearing aid?" Participants who did not use a hearing aid were asked the question, "Is your hearing excellent, very good, good, fair, or poor?" Participants who used hearing aids were asked, "Using a hearing aid as usual, is your hearing excellent, very good, good, fair, or poor?" When subjects were too ill or cognitively impaired to participate, proxy respondents, generally next of kin, provided responses.

We identified potential sociodemographic, clinical, and functional factors that might be associated with a higher prevalence of self-reported poor hearing in late life. Sociodemographic factors included: age at death, gender, self-reported race/ethnicity, wealth, educational attainment, and residence in a residential or long-term care facility. Clinical factors included a self-report of the following physician diagnosed conditions: cancer, heart disease, lung disease, or diabetes. Functional factors included: disability in any of 6 activities of daily living (bathing, dressing, toileting, eating, transferring, and walking across the room), difficulty taking medications, difficulty managing finances, difficulty walking several blocks, and cognitive function (no cognitive impairment, cognitive impairment not dementia, and probable dementia).¹³ We additionally included whether the interview was conducted with the participant or a proxy.

We conducted a sub-analysis of life satisfaction by hearing loss rating during the last two years of life using a single item measure asked of subjects beginning in the 2006 wave of the HRS (n=1,213 in our decedent sample). This question was not asked of proxies. The question read, "Please think about your life-as-a-whole. How satisfied are you with it?" Responses ranged on a 5-point scale from completely satisfied (1) to not at all satisfied (5).

Analysis

We describe the rate of hearing aid use and participant's report of hearing ability, calculating 95% confidence intervals (CI) using a bootstrapping approach. We used two strategies to address the question: how does the prevalence of hearing loss change as death approaches? First, we describe the prevalence of hearing loss among decedents interviewed at 6 month intervals prior to death (19–24 months, 13–18 months, 7–12 months, and 1–6 months prior to death). Second, we compared the prevalence of hearing loss among the sample of participants who died over the next two years to an age and gender propensity matched group of participants who did not die over the next two years. For this analysis, we were able

to match 5,361 (90%) of our cohort of participants who died over the following two years to 5,361 HRS participants who survived for two years following the interview.

We describe the prevalence of a fair or poor rating of hearing across groups of patients defined by sociodemographic, clinical, functional, and HRS-related factors. To ascertain the relative risk of a fair or poor rating of hearing for participants defined by these characteristics, adjusted for age and gender, we conducted a multivariable analysis using a modified poisson approach.¹⁴ We chose not to further adjust because we did not want to over-adjust for additional factors that might lie on the causal pathway to hearing loss in older adults.

For our analysis of life satisfaction, we first compared HRS participants who responded to this question to those who did not. We then compared the ratings of life satisfaction between subjects who rated their hearing as fair or poor during the last two years of life to those who did not rate their hearing as fair or poor. For this analysis, we collapsed ratings of somewhat, very, and completely satisfied into satisfied, and considered not very and not at all satisfied as not satisfied.

We used survey weights to account for the unequal probability of participant selection and the complex survey design.¹⁵ All analysis were conducted using Stata (version 13) and SAS version 9.4 (SAS Institute, Inc., Cary, NC). The Committee on Human Subjects at the University of California, San Francisco, approved the study.

RESULTS

The mean age at death of the 5,895 participants in our cohort was 80 (SD 11 years), 53% were women, 80% were white, 12% African American, and 6% Latino. Twenty-eight percent of interviews were conducted with a proxy.

Self-reported hearing was rated as excellent by 12%, very good by 20%, good by 36%, fair by 21% and poor by 11% (Figure 1). 447 participants reported using hearing aids (7%). Table 1 includes rating of hearing as fair or poor and the prevalence of hearing aid use by participant characteristics. Rates of hearing aid use and fair or poor hearing were highest among the oldest participants, men, white and Latino (vs. African American and other race), education less than high school, heart disease, lung disease, disability in ADL, difficulty with IADL, difficulty walking several blocks, participants who had cognitive impairment not dementia or probably dementia, and proxy interviews. While use of hearing aids and rating of hearing as fair or poor tracked together for these characteristics, they did not track together for wealth. Participants in the highest quartile of wealth were more likely than participants in lower quartiles to report using a hearing aid. However, participants in the highest quartile of wealth reported the lowest prevalence of fair or poor hearing, and participants in the lowest quartile the highest prevalence of fair or poor hearing (Table 1).

Table 2 reports unadjusted and adjusted (for age and gender) relative risk of fair or poor hearing. For many factors, adjustment for age and gender attenuated the strength of the relationship with fair or poor hearing, though significance did not change. Age at death 80

and IADL difficulty were the two factors with relative risk for fair or poor hearing greater than 2.0 ($p < .001$ for both).

The prevalence of hearing loss increased across individuals interviewed at varying time intervals in relation to death. In our first analysis of this phenomena, we found that the prevalence of hearing loss changed from 29% (95% Confidence Interval [CI] 26–33%) among participants interviewed 19–24 months prior to death, to 36% (CI 33–38%) in the last six months of life (p for trend=0.01) (Figure 2). Rates were higher among participants that used hearing aids, although the trend was non-significant (Online Appendix).

In our second analysis we compared rates of fair or poor hearing among participants who died matched by age and gender to participants who survived for at least two years following the interview. We found modest differences in ratings of hearing overall: 31% (95% CI 29–32%) of participants who died within two years of the interview rated their hearing as fair or poor compared to 24% (95% CI 23–26%) of subjects who survived for at least two years after the interview ($p < 0.001$). Differences between ratings were substantial among the sub-group of participants who used hearing aids: 59% (95% CI 54–63%) fair or poor rating among participants who died compared to 39% (95% CI 34–45%) among participants who survived ($p < 0.001$).

Participants who responded to the life-satisfaction question were younger than those who did not (mean age at last interview 74.7 vs. 76.9), less likely to have an education of less than high school (31.6% vs. 41.0%), and less likely to reside in a nursing facility (5.8% vs. 18.1%). None were proxy. Among participants in the sample who rated their hearing as fair or poor, 81.2% were satisfied with life-as-a-whole, compared to 90.3% among those who rated their hearing as good to excellent ($p = 0.001$).

DISCUSSION

These data support the fact that self-reported hearing loss is common near the end of life and increases significantly with age. Between a third and a half of people who die in their 80s and 90s report fair or poor hearing. The prevalence of reported fair to poor hearing in those with hearing aids was strikingly high. Vulnerable populations were at particularly high risk, including the poor, the less educated, the disabled, Latinos, and those with cognitive impairment or dementia. In our sub-analysis, hearing loss in the last two years of life was associated with lower ratings of life satisfaction, a measure of subjective well-being. The prevalence of fair or poor hearing is highest among subjects interviewed closest to death, a finding which has not been documented in this population. Although the data do not allow us to specifically address why this might be true, there are several possibilities.

One is that persons near the end of life have less energy to expend on concentrating. Persons with hearing loss are noted to expend significant cognitive effort in listening because of the way in which hearing loss can distort incoming signals.^{16,17} Another possibility relates to the possible change in hearing across time because of the medications commonly prescribed to people with advanced illness as well as co-morbid conditions. Though we did not find cancer to be associated with hearing loss near the end of life, many chemotherapeutic agents

are ototoxic.¹⁸ Heart disease was strongly associated with hearing loss near death, with about a 50% increased risk for fair or poor hearing compared to those without heart disease. Furosemide, a diuretic commonly used for patients with heart failure, is known to cause ototoxicity in high doses.

Hearing loss is known to influence relationships.^{19–22} These relationships may be especially important during episodes of acute illness and at the end of life. Data support the importance of dyadic communication about end-of-life care preferences so that caregivers who are required to assume decision making responsibilities feel confident in their decisions.²³ Hearing loss makes communication more difficult and can increase the stress on these relationships at a time of vulnerability.

Special attention needs to be paid to older adults with hearing loss nearing the end of life, and their family caregivers, including clinician attention to the issue. In primary care, many clinicians do not screen for or pay attention to hearing loss in their patients.²⁴ There is little reason to suspect that this changes near the end of life. Clinical signs that older adults with serious illness have hearing loss may include lack of understanding, non-adherence, lip reading, or lack of engagement. Clinicians may consider following up suspicious signs with a simple screen for hearing loss, such as the combination of the question, “do you have difficulty hearing?” with either the finger rub or whisper test.²⁵

Potentially effective interventions for hearing loss exist. Hearing aids, which are considered the gold standard, may not always be effective. Patients nearing the end of life may not have the time adapt to hearing aids. As in our study, even when hearing aids are used, hearing may still be impaired if hearing aids are not used correctly or misplaced. Other amplification devices, such as the pocket talker, provide a lower cost alternative. A number of other common sense strategies can enhance communication, including writing, using a low-pitched voice, and rephrasing.¹¹ Many of these simple recommendations can be taught to the caregiver to enhance communication in the home setting.

Management of hearing loss is particularly difficult due to the significant costs wrought on the patient for a high quality hearing aid. In the original 1965 Medicare statute, hearing aids are specifically excluded from coverage, effectively preventing large number of older adults from obtaining a hearing aid.⁸ The fact that wealthy individuals with hearing loss were less likely to report fair to poor hearing may be related to their ability to obtain the most technologically advanced hearing aids.

There are limitations to the study. Our questions on hearing use are limited to those included in the HRS. These include questions on self-reported hearing and use of hearing aids. The HRS does not include questions that are found in other surveys of hearing loss, including questions about the ability to hear at varying levels of background noise, or the impact of hearing loss on communication and social functioning.²⁶ Measured hearing ability was not assessed. Finally, we relied on proxy reports when patients were too ill or cognitively impaired to participate in the HRS interview. Proxy interviews were more common near the end of life, and this may have impacted ratings of hearing for participants near death.

However, this strategy mirrors what a clinician would likely rely on in practice – the report of a caregiver of the patient’s hearing ability.

In conclusion, self-reported hearing loss is highly prevalent near the end of life. Nearly one in three older adults report fair or poor hearing during the last two years of life. As self-reported hearing loss is low compared to objective measures,^{1,2,4-6} this is likely a conservative estimate.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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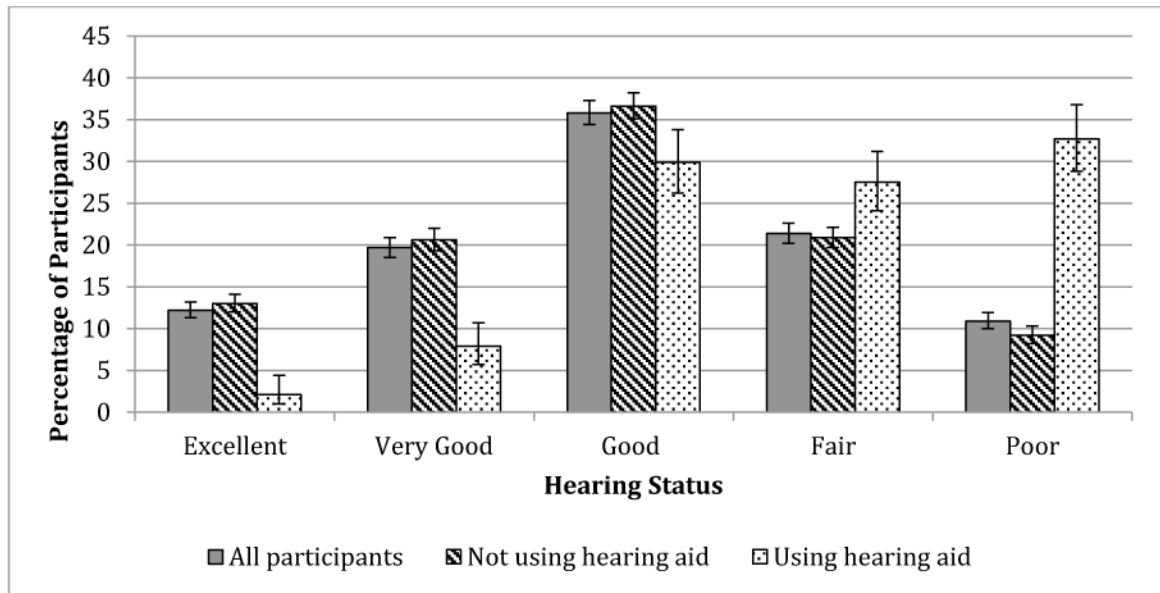


Figure 1.
Self-Reported Rating of Hearing at the Last Interview before Death by Hearing Aid Use
(n=5,895)

Table 1

Prevalence of Self-reported Fair/Poor Hearing and Hearing Aid Use and in Subpopulations of Decedents (n=5,895)*

Characteristics	Number of Participants	Participants Rate Hearing Fair/Poor	Participants Using Hearing Aids
	n	% (95% CI)	% (95% CI)
Sociodemographic Factors			
Age at death, year			
Mean		81.2 (11.1)	84.7 (8.9)
50 – 59	291	22.3 (17.7 – 27.7)	1.2 (0.4 – 3.9)
60 – 69	971	21.4 (18.4 – 24.6)	2.3 (1.5 – 3.6)
70 – 79	1682	26.2 (24.2 – 28.3)	5.6 (4.4 – 7.0)
89 – 89	1972	37.7 (35.5 – 40.0)	9.5 (8.3 – 11.0)
90	979	49.9 (47.0 – 52.9)	15.3 (12.6 – 18.5)
Gender			
Men	2712	34.5 (32.6 – 36.5)	8.3 (7.2 – 9.4)
Women	3183	30.3 (28.7 – 32.0)	6.6 (5.7 – 7.6)
Race/Ethnicity			
White	4325	32.5 (31.0 – 34.0)	8.2 (7.4 – 9.2)
Black	1027	26.7 (23.7 – 29.9)	2.0 (1.5 – 2.9)
Hispanic	424	41.5 (36.8 – 46.3)	7.3 (5.0 – 10.6)
Other	119	32.0 (20.9 – 45.4)	4.3 (1.8 – 10.0)
Wealth at last core interview prior to death			
Median (1 st , 3 rd quartile)		62000 (2000, 206300)	116776 (12000, 320000)
Lowest quartile (< \$5264)	1555	38.0 (35.6 – 40.4)	6.8 (5.5 – 8.3)
\$ >5264 – 82000	1518	32.4 (29.5 – 35.5)	6.0 (4.6 – 7.7)
\$ >82000 – 265000	1420	31.8 (29.1 – 34.6)	8.1 (6.9 – 9.6)
Highest quartile (>\$265000)	1402	26.9 (24.7 – 29.3)	8.6 (7.1 – 10.5)
Education			
Less than high school	2523	38.4 (36.5 – 40.4)	8.1 (6.8 – 9.6)
High school or higher	3369	28.4 (26.6 – 30.2)	6.9 (9.4 – 14.6)
Nursing home resident	946	43.6 (40.7 – 46.5)	11.7 (9.4 – 14.6)
Clinical Factors			
Chronic conditions			
Cancer			
No	4337	32.7 (31.2 – 34.2)	7.0 (6.1 – 8.0)
Yes	1545	31.2 (28.4 – 34.2)	8.4 (7.1 – 9.9)
Heart disease			
No	3065	27.2 (25.1 – 29.4)	6.1 (5.2 – 7.1)

Characteristics	Number of Participants	Participants Rate Hearing Fair/Poor	Participants Using Hearing Aids
	n	% (95% CI)	% (95% CI)
Yes	2816	38.2 (36.2 – 40.2)	8.8 (7.7 – 10.1)
Lung disease			
No	4634	31.1 (29.7 – 32.5)	7.4 (6.6 – 8.4)
Yes	1247	36.6 (33.7 – 39.6)	7.0 (5.8 – 8.5)
Diabetes			
No	4142	32.1 (30.6 – 33.7)	7.7 (6.8 – 8.6)
Yes	1737	32.7 (29.5 – 36.1)	6.6 (5.5 – 7.9)
Functional Factors			
ADL dependence [6 ADL items]			
No	3515	26.0 (24.2 – 27.9)	6.1 (5.3 – 7.1)
Yes	2364	42.2 (40.1 – 44.2)	9.4 (8.1 – 10.9)
IADL dependence [5 IADL items]			
No	2842	23.1 (21.2 – 25.2)	5.4 (4.6 – 6.3)
Yes	3053	41.4 (39.6 – 43.2)	9.4 (8.3 – 10.6)
Difficulty: walking several blocks			
No	1588	21.4 (19.0 – 24.1)	5.6 (4.5 – 6.9)
Yes	3926	36.6 (35.2 – 38.1)	8.1 (7.1 – 9.1)
Cognitive Status			
No cognitive impairment	2364	24.3 (22.3 – 26.5)	4.6 (3.7 – 5.6)
Cognitive impairment without dementia	1589	32.6 (29.6 – 35.8)	8.2 (7.1 – 9.4)
Probable dementia	1906	44.0 (41.8 – 46.2)	10.7 (9.2 – 12.5)
Participant type			
Self-reported	4218	27.4 (25.7 – 29.1)	5.2 (4.6 – 6.0)
Proxy reported	1677	46.4 (44.2 – 48.6)	13.5 (11.8 – 15.5)

* Reported values incorporate survey weights to account for the complex survey design. Abbreviations: ADL, Activities of Daily Living (bathing, toileting, dressing, eating, transferring from bed to chair, and walking across the room). IADL, Instrumental Activities of Daily Living (managing finances, managing medications, shopping, preparing meals, and making phone calls).

Table 2

Unadjusted and Adjusted Risk for Self-Reported Fair/Poor Hearing at the Last Interview before Death (n=5,895)*

Characteristics	Unadjusted Relative Risk		Adjusted Relative Risk	
	RR (95% CI)	P Value	RR (95% CI)	P Value
Sociodemographic Factors				
Age at death, year				
50 – 59	Ref.		Ref.	
60 – 69	0.94 (0.67 – 1.33)	0.74	0.95 (0.67 – 1.35)	0.78
70 – 79	1.24 (0.93 – 1.65)	0.14	1.28 (0.96 – 1.72)	0.10
89 – 89	2.10 (1.56 – 2.84)	<0.001	2.28 (1.67 – 3.10)	<0.001
90	3.47 (2.51 – 4.79)	<0.001	3.99 (2.89 – 5.52)	<0.001
Gender				
Men	Ref.		Ref.	
Women	0.83 (0.74 – 0.92)	0.001	0.67 (0.59 – 0.75)	<0.001
Race/Ethnicity				
White	Ref.		Ref.	
Black	0.76 (0.63 – 0.91)	0.003	0.86 (0.70 – 1.05)	0.13
Hispanic	1.47 (1.21 – 1.80)	<0.001	1.60 (1.30 – 1.96)	<0.001
Other	0.98 (0.56 – 1.71)	0.93	1.04 (0.58 – 1.86)	0.88
Wealth at last core interview prior to death				
Lowest quartile (\$5264)	1.66 (1.42 – 1.95)	<0.001	1.91 (1.61 – 2.26)	<0.001
\$ >5264 – 82000	1.30 (1.08 – 1.57)	0.006	1.44 (1.20 – 1.74)	<0.001
\$ >82000 – 265000	1.26 (1.09 – 1.47)	0.003	1.33 (1.13 – 1.56)	0.001
Highest quartile (>\$265000)	Ref.		Ref.	
Education				
Less than high school	1.58 (1.40 – 1.78)	<0.001	1.50 (1.33 – 1.70)	<0.001
High school or higher	Ref.		Ref.	
Nursing home resident	1.78 (1.55 – 2.05)	<0.001	1.37 (1.17 – 1.61)	<0.001
Clinical Factors				
Chronic conditions				
Cancer	0.93 (0.80 – 1.09)	0.36	1.01 (0.87 – 1.17)	0.93
Heart disease	1.66 (1.42 – 1.93)	<0.001	1.52 (1.31 – 1.76)	<0.001
Lung disease	1.28 (1.12 – 1.46)	<0.001	1.46 (1.27 – 1.67)	<0.001
Diabetes	1.03 (0.86 – 1.23)	0.76	1.20 (1.00 – 1.43)	0.05
Functional status				
Functional status				
ADL dependence [6 ADL items]	2.07 (1.82 – 2.36)	<0.001	1.82 (1.58 – 2.09)	<0.001
IADL difficulty [5 IADL items]	2.35 (2.06 – 2.67)	<0.001	2.11 (1.85 – 2.41)	<0.001
Cognitive Status				

Characteristics	Unadjusted Relative Risk		Adjusted Relative Risk	
	RR (95% CI)	P Value	RR (95% CI)	P Value
No cognitive impairment	Ref.		Ref.	
Cognitive impairment without dementia	1.51 (1.27 – 1.79)	<0.001	1.29 (1.07 – 1.57)	0.01
Probable dementia	2.44 (2.09 – 2.86)	<0.001	1.86 (1.57 – 2.20)	<0.001
Participant type				
Self-reported	Ref.		Ref.	
Proxy reported	2.30 (2.02 – 2.61)	<0.001	1.89 (1.65 – 2.16)	<0.001

* Adjusted for age and gender. Reported values incorporate survey weights to account for the complex survey design. Abbreviations: ADL, Activities of Daily Living (bathing, toileting, dressing, eating, transferring from bed to chair, and walking across the room). IADL, Instrumental Activities of Daily Living (managing finances, managing medications, shopping, preparing meals, and making phone calls).