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The Impact of Hearing Loss on Quality of Life in Older Adults

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Purpose: The authors investigate the impact of hearing loss on quality of life in a large population of older adults. ***Design and Methods:*** Data are from the 5-year follow-up Epidemiology of Hearing Loss Study, a population-based longitudinal study of age-related hearing impairment conducted in Beaver Dam, WI. Participants (N = 2,688) were 53–97 years old (mean = 69 years) and 42% were male. Difficulties with communication were assessed by using the Hearing Handicap for the Elderly—Screening version (HHIE-S), with additional questions regarding communication difficulties in specific situations. Health-related quality of life was assessed by using measures of activities of daily living (ADLs), instrumental ADLs (IADLs) and the Short Form 36 Health Survey (SF-36). Hearing loss measured by audiometry was categorized on the basis of the pure-tone average of hearing thresholds at 0.5, 1, 2, and 4 kHz. ***Results:*** Of participants, 28% had a mild hearing loss and 24% had a moderate to severe hearing loss. Severity of hearing loss was significantly associated with having a hearing handicap and with self-reported communication difficulties. Individuals with moderate to severe hearing loss were more likely than individuals without hearing loss to have impaired ADLs and IADLs. Severity of hearing loss was significantly associated with decreased function in both the Mental Component Summary score and the Physical Component Summary score of the SF-36 as well as with six of the eight individual domain scores. ***Implications:*** Severity of hearing loss is associated with reduced quality of life in older adults.

Key Words: Aging, Epidemiology, SF-36, Activities of daily living

Hearing loss is one of the most prevalent chronic conditions affecting older adults. The Epidemiology of Hearing Loss Study, a population-based study of age-related hearing loss conducted in 1993–1995, found that 46% of adults aged 48–87 years had a hearing loss (Cruickshanks et al., 1998). There has been a 14% increase in the age-adjusted prevalence of self-reported hearing loss between the 1971 and 1990–1991 Health Interview Survey (Ries, 1994). In the 1990–1991 survey, only 9.7% of the respondents over the age of 65 had normal hearing and nearly 50% of the individuals who could not hear and understand normal speech had activity limitations caused by chronic conditions (Ries, 1994).

Exchange of information with others, an important aspect of everyday life, can be seriously impaired in individuals with hearing loss. These difficulties with communication could lead to a perceived reduction in quality of life. As life expectancy increases and older adults are living longer, an increasing number of individuals will be forced to endure hearing loss during their senior years. Understanding the impact of hearing loss on quality of life is of great importance.

Although several studies have investigated the association of hearing loss and quality of life, there are few population-based data to describe the impact of hearing loss on quality of life in older adults. Most previously reported population-based studies have not used standardized audiometric measurement techniques but rather have relied on functional measures (Appollonio, Carabellese, Frattola, & Trabucchi, 1996; Appollonio, Carabellese, Magni, Frattola, & Trabucchi, 1995; Carabellese et al., 1993) or self-report to determine hearing status (Cacciatore et al., 1999; Campbell, Crews, Moriarty, Zack, & Blackman, 1999; Rudberg, Furner, Dunn, &

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Cassel, 1993; Strawbridge, Wallhagen, Shema, & Kaplan, 2000). It has been shown that self-report underestimates the prevalence of hearing loss (Nondahl et al., 1998). Additionally, people in different age groups are likely to report a hearing handicap differently, with older people being less likely to report hearing difficulties compared with younger respondents (Wiley, Cruickshanks, Nondahl, & Tweed, 2000). In essence, these studies compared self-perceived hearing function, rather than actual hearing loss, with quality of life.

Other studies that have investigated the association between hearing loss and quality of life have utilized clinical series or other convenience samples that may not be representative of the general older population (Bazargan, Baker, & Bazargan, 2001; Bess, Lichtenstein, Logan, Burger, & Nelson, 1989; Mulrow, Aguilar, Endicott, Tuley, et al., 1990; Mulrow, Aguilar, Endicott, Velez, et al., 1990; Pope & Sowers, 2000; Scherer & Frisina, 1998; Thomas et al., 1983). Most of these studies have found hearing loss to be adversely associated with some measure of quality of life; however, comparisons between studies is difficult because of differences in the instruments used to quantify quality of life and differences in the methods used to determine hearing loss.

The purpose of this paper is to investigate the impact of hearing loss on hearing handicap, communication difficulties, function, and health-related quality of life in a large population of older adults by using standardized audiometric testing procedures and health-related quality of life measures.

Methods

Audiometric, medical history and quality of life data used in these analyses are from the 5-year follow-up of the Epidemiology of Hearing Loss Study (EHLS-2), a population-based longitudinal study of age-related hearing loss conducted in Beaver Dam, Wisconsin, between March 1998 and July 2000. Eligibility criteria for this study have been previously reported (Cruickshanks et al., 1998). In brief, a private census (Klein, Klein, & Lee, 1996) of the city and township of Beaver Dam conducted in 1987–1988 identified 5,924 individuals in the target age range of 43–84 years for the baseline Beaver Dam Eye Study (BDES). All individuals who had participated in the baseline BDES who were still alive as of March 1, 1993 ($N = 4{,}541$) were eligible to participate in the baseline EHLS (March 1993–July 1995, $n = 3{,}753$). All participants of the baseline EHLS who were still alive as of March 1, 1998, were invited to participate in the EHLS-2. Of the surviving 3,407 eligible participants, 2,800 (82%) participated in the EHLS-2.

Air- and bone-conduction hearing thresholds were obtained by using GSI-61 clinical audiometers (Lucas GSI, Inc., Littleton, MA) and TDH-50 headphones in sound-treated booths (Industrial Acoustics Company, New York, NY) following American Speech Language and Hearing Association (ASHA) guidelines (ASHA, 1978). Insert earphones (E-A-Rtone 3A; Cabot Safety Corp., Indianapolis, Indiana) and masking were used when necessary. Participants who were not able to come to the study examination site ($n = 139$) were tested at home or in the nursing home with a Beltone 112 portable audiometer (Beltone Electronic Corp., Chicago, IL). All audiometric equipment complied with American National Standards Institute (ANSI) standards (ANSI, 1989) and was recalibrated every 6 months. Pure-tone air-conduction thresholds were measured at 0.25, 0.5, 1, 2, 3, 4, 6, and 8 kHz in each ear. Bone-conduction thresholds were measured at 0.5, 2, and 4 kHz.

Pure-tone averages (PTA) were calculated for the thresholds at 0.5, 1, 2, and 4 kHz in each ear. Hearing loss was categorized as mild if the PTA was 26–40 dB HL in either ear and moderate to severe if the PTA was greater than 40 dB HL in either ear.

The Hearing Handicap Inventory for the Elderly—Screening version (HHIE-S) and additional questions regarding difficulties with communication were used to determine perceived hearing handicap and communication-specific problems (Ventry & Weinstein, 1983). The HHIE-S is a series of 10 standardized questions developed to screen for self-assessed hearing handicap in elderly individuals. The questions consist of five social or situational items and five emotional response items. A response of "yes" is given 4 points, "sometimes" is given 2 points, and "no" is given 0 points. HHIE-S scores range from 0 to 40, with a score of 8 or higher indicative of at least a mild hearing handicap (Ventry & Weinstein, 1983).

Participants were also asked six additional questions pertaining to hearing-related communication difficulties in specific situations. Participants were asked if they had trouble in the following situations: talking with a cashier at the store, understanding dialogue in a movie or at the theater, being able to follow the conversation when at a physician's office, understanding conversations when several people are talking, and understanding the conversation when talking on the telephone. Possible responses were "no," "yes," and "sometimes." Participants were asked how much their hearing limited them from hearing when in a noisy large group of people, with possible responses being "none," "a little," or "a lot." An individual was considered to have problems with communication if he or she answered "yes" or "sometimes" to any of the first five questions or answered "a lot" to the last question.

Information on more global functioning was obtained by interview with questions regarding activities of daily living (ADLs) and instrumental ADLs (IADL; Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963; Lawton & Brody, 1969). The ADL questions asked if, during the past month, the participant

needed help from another person or special piece of equipment or device to perform any of the following activities: walking across a small room, bathing, personal grooming (brushing hair, brushing teeth, washing face), dressing, eating, getting from a bed to a chair, and using the toilet. Participants were then asked to rate how much difficulty they had performing these activities (with help if help was needed), using the categories of "none," "a little," "some," or "a lot." Participants reporting that they needed help with any of the activities or that they had some or a lot of difficulty performing any of the activities were considered to have impaired ADL.

The IADL addressed the following activities: pulling or pushing large objects, lifting or carrying weights under 10 lb, extending arms above shoulder level, preparing meals, shopping for personal items, managing money, using the telephone, doing heavy housework, doing light housework, and doing laundry. Participants were asked how much difficulty they had doing each of these activities within the past month. Participants who reported some or a lot of difficulty, or who reported not being able to perform one or more of these activities, were considered to have impaired IADL.

The Short Form 36 Health Survey (SF-36) was used to assess health-related quality of life. The SF-36 is a standardized series of 36 questions developed for use by the Medical Outcomes Study in America (Ware, 1993). It has been shown to be suitable for use in elderly populations (Lyons, Perry, & Littlepage, 1994). It measures eight domains of health status: physical functioning, role physical, bodily pain, general health perception, vitality, social functioning, role emotional, and mental health. For each domain a score from 0 to 100 is calculated, with higher scores indicating better health. Additionally, two summary scores were calculated by using a factor analytic method: the Physical Health Component Score (PCS), which emphasizes the physical function, role physical, bodily pain, and general health scores; and the Mental Health Component Score (MCS), which emphasizes the vitality, social functioning, role emotional, and mental health scores.

Information concerning potential confounders including sleep problems (Schubert, Cruickshanks, Dalton, & Nondahl, 2001) and history of arthritis and other chronic diseases (cancer, cardiovascular disease, emphysema and diabetes) was obtained by interview. Current binocular visual acuity was measured by using the Early Treatment Diabetic Retinopathy Study chart R during the BDES-3 examination, which was conducted concurrently with the EHLS-2 (Klein, Klein, Lee, Cruickshanks, & Chappell, 2001).

The medical history interview was completed by a surrogate if the participant was unable to respond to the questionnaire as a result of aphasia, dementia, or milder cognitive problems. However, because of the highly subjective nature of the HHIE-S, SF-36, and the questions regarding communication difficulties, these questions were not asked of surrogate responders.

SAS (SAS Institute, Inc., 1999) was used for all analyses. The Mantel–Haenszel chi-square test for trend was used to compare characteristics between the hearing loss categories. Logistic regression was used to evaluate the odds of having impaired function by hearing loss status while potential confounders were controlled for. An F test for linear trend was used to assess the association between SF-36 scores and hearing loss categories while potential confounders were controlled for.

Results

Of the 2,800 study participants, analyzable audiometric data were available for 2,688. Descriptive characteristics of these individuals are shown in Table 1. The mean age of participants was 69 (range 53–97) years and 42% were male. More than half (51%) of the participants were classified as having a hearing loss. Of those, 27.5% had a mild loss and 23.8% had a moderate to severe loss. In unadjusted analyses, hearing loss severity was associated with age, male gender, less education, chronic health problems, and problems sleeping.

Severity of hearing loss was significantly associated with having a hearing handicap and with self-reported communication difficulties (Table 2). In each age group, the prevalence of self-reported hearing handicap or communication difficulties increased with the severity of the hearing loss as measured by audiometry. However, among those with moderate to severe losses, as measured by audiometry, many people did not report having a hearing handicap or any communication difficulties.

The unadjusted mean HHIE-S score was 5.7 for the study population. After age, sex, and education were adjusted for, the mean HHIE-S score was 1.7 for individuals classified as not having a hearing loss, 5.7 for those with a mild hearing loss, and 14.3 for those with moderate to severe hearing loss. Sixteen percent of the study participants had a score > 8, a level considered indicative of a hearing handicap (Ventry & Weinstein, 1983). When age, sex, and education were adjusted for, participants with a moderate to severe hearing loss were 34 times as likely as participants without a hearing loss to have impaired HHIE-S scores (> 8), and participants with mild hearing loss were 6 times as likely as participants without a hearing loss to have impaired HHIE-S scores (moderate to severe hearing loss odds ratio [OR] = 34.23, 95% confidence interval [CI] = 23.82–49.18; mild hearing loss OR = 6.22, 95% CI = 4.46–8.68).

Overall, 52% of the study participants reported having problems with communication. Participants with moderate to severe hearing loss were almost eight times as likely as those without hearing loss to have self-reported difficulties with communication,

Table 1. Descriptive Characteristics of Study Participants

Characteristic	All		No HL		Mild HL		Mod.–Severe HL		*p* Value[a]
	n	%	*n*	%	*n*	%	*n*	%	
N (or *n*)	2688		1281		740		640		
Age (years)	69		64		71		77		<.001[b]
% Male	42		31		52		54		<.001
Education (years)									<.001
<12	509	19.1	135	10.6	171	23.1	203	31.8	
12	1279	48.1	635	49.6	364	49.2	280	43.8	
13–15	428	16.1	235	18.4	98	13.2	95	14.9	
≥16	443	16.7	275	21.5	107	14.5	61	9.6	
Arthritis	1179	45.9	514	41.2	334	47.1	331	54.2	<.001
Cancer (excl. skin)	311	12.1	112	9.0	100	14.1	99	16.2	<.001
Cardiovas. disease	453	17.7	122	9.8	155	21.9	176	29.0	<.001
Emphysema	89	3.5	26	2.1	32	4.5	31	5.1	<.001
Diabetes	298	11.6	111	8.9	89	12.6	98	16.1	<.001
Impaired vision	149	5.8	19	1.5	47	6.6	83	13.7	<.001
Sleep problems	1301	49.6	595	46.6	382	52.5	324	52.6	.006

Note: HL = hearing loss.
[a]This is by use of a Mantel-Haenszel chi-square test for trend.
[b]This is by use of a *t* test of least square means. The mean age for each group is significantly different from the other groups.

and participants with mild hearing loss nearly three times as likely as those without hearing loss to report difficulties with communication (moderate to severe hearing loss OR = 7.67, 95% CI = 5.85–10.05; mild hearing loss OR = 2.71, 95% CI = 2.20–3.33).

The percentage of participants reporting difficulties with ADLs and IADLs are shown in Table 3. Severity of hearing loss was associated with ADL and IADL impairments in most age groups. Individuals with a moderate to severe hearing loss were significantly more likely than individuals without hearing loss to have impaired ADL and IADL after age, sex, education, arthritis, other chronic diseases, and impaired visual acuity were controlled for (ADL OR = 1.54, 95% CI = 1.06–2.24; IADL OR = 1.54, 95% CI = 1.18–2.00).

Severity of hearing loss, hearing handicap as determined by having an HHIE-S > 8, and self-report of communication difficulties were all associated with reduced quality of life as measured by the SF-36 (Table 4). Severity of hearing loss was associated with significantly lower scores on six of the eight individual domain scores: vitality, social functioning, role emotional, mental health, role physical, and physical functioning. There was no significant association between severity of hearing loss and general health or bodily pain, although the scores in these domains did decline with increasing hearing loss. Having an HHIE-S score > 8 and self-report of communication difficulties were significantly associated with reduced SF-36 scores in all domains.

Table 2. Percentage of Study Participants With an HHIE-S score > 8 and Communication Difficulties

Handicap	No HL		Mild HL		Mod.–Severe HL		*p* Value[a]
	n	%	*n*	%	*n*	%	
HHIE score > 8							
All	61	4.8	160	21.9	345	56.3	<.001
52–59 years	26	5.8	32	34.4	30	69.8	<.001
60–69 years	25	4.7	62	25.9	75	67.6	<.001
70–79 years	10	3.8	55	19.0	114	51.6	<.001
80–97 years	0	0	11	10.1	126	52.9	<.001
Communication difficulties							
All	428	33.4	436	59.3	504	80.4	<.001
52–59 years	149	33.3	65	69.9	33	76.7	<.001
60–69 years	173	32.6	150	62.8	90	79.7	<.001
70–79 years	94	35.6	169	57.7	183	81.3	<.001
80–97 years	12	31.6	53	47.3	198	80.5	<.001

Notes: Communication difficulties are self-reported. HHIE-S = Hearing Handicap Inventory for the Elderly—Screening version; HL = hearing loss.
[a]This is by use of a Mantel-Haenszel chi-square test for trend.

Table 3. Percentage of Study Participants With Impaired ADLs and IADLs

	No HL		Mild HL		Mod.–Severe HL		
Impairment	*n*	%	*n*	%	*n*	%	*p* Value[a]
Impaired ADL							
All	92	7.3	108	14.9	174	27.9	<.001
52–59 years	20	4.5	7	7.6	3	7.3	.22
60–69 years	32	6.1	19	8.1	11	9.8	.12
70–79 years	33	12.6	47	16.3	54	24.3	.001
80–97 years	7	18.4	35	31.5	106	42.6	.001
Impaired IADL							
All	436	34.6	338	46.7	359	59.1	<.001
52–59 years	123	28.0	25	27.2	12	29.3	.95
60–69 years	177	33.8	84	35.6	52	46.9	.02
70–79 years	118	45.2	161	55.9	122	55.5	.02
80–97 years	18	47.4	68	63.0	173	73.3	.001

Note: ADL = activity of daily living; IADL = instrumental ADL; HL = hearing loss.
[a]This is by use of a Mantel-Haenszel chi-square test for trend.

Severity of hearing loss, hearing handicap, and self-report of communication problems also were significantly associated with lower summary scores for both the MCS and the PCS. The mean summary scores adjusting for age, sex, education, arthritis, chronic disease, impaired vision, and sleep problems are shown in Table 5.

Subset analyses excluding individuals who reported currently wearing a hearing aid yielded similar results for the SF-36 MCS and PCS. The mean adjusted PCS for individuals not currently wearing a hearing aid who had a moderate to severe hearing loss was 38.3 compared with 38.8 for the total population. The mean adjusted MCS for a moderate to severe hearing loss was the same (49.0) for those not currently wearing a hearing aid and the total population. Hearing aid use was very low. Only 213 or 15.6% of individuals classified as having a hearing loss currently used a hearing aid (2.6% with mild hearing loss and 31.1% with moderate to severe hearing loss).

Discussion

In spite of the importance of hearing in everyday life, hearing loss is often an unrecognized and undertreated health disorder. Even among people with hearing impairment, there may be a tendency to un-

Table 4. Adjusted SF-36 Individual Domain Scores by Hearing Status, HHIE-S Score, and Communication Difficulties

Hearing Status	Phys. Func.	Role Physical	Bodily Pain	Gen. Health	Vitality	Social Func.	Role Emotional	Mental Health
N[a]	2505	2504	2503	2502	2502	2503	2502	2501
Hearing status								
No HL	55.0 (4.44)	61.9 (6.95)	65.5 (4.59)	61.8 (3.71)	52.6 (3.86)	67.8 (3.72)	68.6 (4.90)	76.7 (3.12)
Mild HL	51.7 (4.47)	58.8 (6.99)	65.2 (4.62)	61.2 (3.73)	51.6 (3.89)	67.1 (3.74)	67.0 (4.93)	75.4 (3.14)
Mod.–severe HL	49.8 (4.49)	56.0 (7.02)	63.6 (4.63)	59.7 (3.75)	48.4 (3.90)	65.2 (3.76)	64.7 (4.95)	74.1 (3.15)
p value[b]	<.0001	.003	.18	.06	.0003	.02	.01	.004
HHIE-S score								
≤ 8	53.9 (4.4)	62.0 (6.9)	66.4 (4.6)	62.3 (3.7)	52.8 (3.8)	68.2 (3.7)	68.7 (4.9)	77.1 (3.1)
> 8	50.5 (4.5)	52.2 (7.0)	62.0 (4.6)	58.6 (3.7)	47.1 (3.9)	63.0 (3.7)	62.1 (4.9)	72.6 (3.1)
p value[c]	.0014	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Com. difficulties								
No	54.7 (4.5)	63.3 (6.9)	67.0 (4.6)	63.1 (3.7)	54.8 (3.8)	68.4 (3.7)	69.2 (4.9)	78.1 (3.1)
Yes	51.7 (4.4)	57.5 (6.9)	63.8 (4.6)	60.0 (3.7)	49.3 (3.8)	66.1 (3.7)	66.1 (4.9)	74.4 (3.1)
p value[c]	.0006	<.0001	.0005	<.0001	<.0001	.0023	.0009	<.0001

Notes: Individual scores are adjusted for age, sex, education, chronic disease, arthritis, impaired visual acuity, and sleep problems. The means are given first, followed parenthetically by standard errors. HHIE-S = Hearing Handicap Inventory for the Elderly—Screening version; SF-36 = Short Form 36 Health Survey. Communication (Com.) difficulties are self-reported.
[a]The total *N* varies slightly between each scale as a result of missing data.
[b]This is by use of an *F* test for linear trend.
[c]This is by use of a *T* test for difference in mean scores.

Table 5. Adjusted SF-36 Component Scores by Hearing Status, HHIE-S Score, and Communication Difficulties

Hearing Status	PCS	MCS
N[a]	2496	2516
Hearing status		
No HL	40.3 (1.87)	50.2 (1.59)
Mild HL	39.5 (1.88)	49.9 (1.60)
Mod.–severe HL	38.8 (1.89)	49.0 (1.61)
p value[b]	.004	.01
HHIE-S score		
≤8	40.3 (1.9)	50.5 (1.6)
>8	38.4 (1.9)	48.0 (1.6)
p value[c]	<.0001	<.0001
Com. difficulties		
No	40.6 (1.9)	50.9 (1.6)
Yes	39.2 (1.9)	49.3 (1.6)
p value[c]	.0002	<.0001

Notes: Component scores are adjusted for age, sex, education, chronic disease, arthritis, impaired visual acuity, and sleep problems. The means are given first, followed parenthetically by standard errors. SF-36 = Short Form 36 Health Survey; HHIE-S = Hearing Handicap Inventory for the Elderly—Screening version; HL = hearing loss; PCS = Physical Health Component Score; MCS = Mental Health Component Score. Communication (Com.) difficulties are self-reported.

[a]Total N varies slightly between scales as a result of missing data.

[b]This is by use of an F test for linear trend.

[c]This is by use of a T test for difference in mean scores.

derreport hearing-related difficulties. In these analyses, only 22% of people with a mild hearing loss reported a hearing handicap on the HHIE-S and 56% with a moderate to severe hearing loss reported a hearing handicap. Self-report of difficulties with communication were more common in this population, with 59% of people with a mild hearing loss and 80% of people with a moderate to severe hearing loss reporting communication difficulties.

One of the limitations of this study is that quality of life, hearing handicap, and difficulties with communication were determined by self-report from the participant. Although hearing loss certainly affects the individual, it is likely that family members and other individuals dealing with the hearing-impaired person experience as much, or possibly more, frustration as a result of communication difficulties. It also is possible that individuals living with the hearing-impaired person may be more objective about reporting the impact of hearing loss on communication. When investigating the quality of life of people with hearing loss, it may be informative to evaluate the impact of hearing loss on the family as well as the individual. Some international studies investigating effectiveness of hearing aids are adding questions specifically for the partner of the person with the hearing aid (Noble, 2002).

In this study, hearing loss was associated with reduced functioning as measured by ADLs and IADLs. The ADLs measure more global functioning in activities that are part of everyday living, such as walking across a small room, toileting, and getting from a bed to a chair. Hearing loss is not likely to be the direct cause of this reduction in physical function; however, even after other factors are controlled for, it remains that people with hearing loss have more difficulty with these tasks. This demonstrates that hearing loss accompanies the general decline and frailty that can occur with aging and is an important piece in understanding the effects of comorbidity on the loss of quality of life in aging populations. The IADLs measure functioning in more subtle activities, including shopping for personal items, taking care of personal finances, preparing meals, and talking on the telephone. It is not surprising that hearing loss would be associated with reduced function in these areas. Communication is an important aspect of daily living. With hearing loss and the resulting communication problems, difficulties with these IADLs could be expected.

Hearing handicap (HHIE-S $>$ 8) and self-report of communication difficulties were associated with decreased scores in each of the individual domains of the SF-36. Hearing loss, determined by audiometry, was associated with decreased scores in six of the eight individual domains. Although the absolute differences in the mean scores between the levels of hearing loss are small, they are likely to be important. The developers of the SF-36 suggested that differences as small as 2 points on the 100-point scale used for the individual domains are important to detect in population bases studies (Ware, 1993).

Of the three measures of hearing, hearing handicap (HHIE-S $>$ 8) resulted in the greatest difference in SF-36 scores. For example, in the social functioning domain, the difference between those with no hearing loss vs. those with a moderate to severe hearing loss was 2.6, the difference between those with no self-report of communication problems vs. those with communication problems was 2.3 and the difference between those with HHIE-S $\leq$ 8 vs. $>$ 8 was 5.2. This may reflect a greater severity of hearing loss in those reporting hearing handicap or that people who report feeling handicapped by their hearing may be more likely to report problems with other activities as well. Using audiometric measures of hearing loss may capture a less biased view of the overall impact of hearing loss on quality of life across the spectrum of hearing impairments present in a population.

Each of the three measures was also associated with decreased scores on the MCS and PCS of the SF-36. These differences in the MCS and PCS, although small, are consistent with published data demonstrating differences in people with hearing loss compared with the general population means (Ware, Kosinski, & Keller, 1994). The MCS and PCS are scaled so a 10-point difference represents 1 standard deviation and is comparable with a 20- to 30-point

difference in the eight individual domain scores. The overall MCS and PCS scores for study participants were slightly higher than the published population norms for men and women aged 65–74 years, indicating that the residents in Beaver Dam tend to report better health (EHLS overall MCS = 55.0, PCS = 45.2 vs. population norm MCS = 52.7, PCS = 43.3). However, the hearing impaired study participants had lower PCS scores compared with published norms for the hearing impaired (PCS = 38.8 for moderate to severe hearing loss vs. 43.7 published norm for the hearing impaired). This may reflect the younger age of the hearing impaired sample used in the published norms. The MCS for study participants with moderate to severe hearing loss is very similar to the published norms for hearing impaired people (49.0 vs. 48.7).

A randomized trial of hearing aid use conducted at the San Antonio VA Hospital demonstrated that the use of hearing aids could reverse adverse effects on the quality of life in elderly adults with hearing loss (Mulrow, Aguilar, Endicott, Velez, et al., 1990). In the current analyses, eliminating those with hearing aids did not alter the association; however, hearing aid use was very low in this population. More than half of the participants in this study were classified as having a hearing loss, yet only 15.6% of these individuals reported that they currently use a hearing aid. This is consistent with previous analyses from the baseline examination of the EHLS that found the prevalence of hearing aid use to be 14.6% (Popelka et al., 1998).

In these analyses, hearing loss was also associated with employment. Among men younger than 65 years of age, those with a hearing loss were less likely to be employed full time than men with normal hearing. Although this is a cross-sectional relationship, it does point out the possibility that hearing loss could have serious economic implications for individuals as well as families in which the main wage earner is not able to work due to hearing impairment.

To our knowledge, this is the only population-based study that has investigated the impact of hearing loss on quality of life by using standardized audiometric techniques as well as self-reported hearing handicap and communication difficulties. Hearing handicap and health-related quality of life measures were obtained by using standardized instruments that are well documented in the literature. Additionally, the large size of this representative cohort lends strength to these analyses. However, these data are cross-sectional, so it is not possible to determine if the hearing loss preceded the perceived reduction in quality of life. In addition, the measures of handicap and quality of life were obtained by self-report. Although known confounders were controlled for in the analyses, it is possible that there could be residual confounding by other comorbid conditions.

Hearing loss is a common chronic condition affecting older adults, and it is important for us to understand its impact on quality of life. There may be a tendency to dismiss hearing loss as being either unimportant or an inevitable aspect of aging. However, as these analyses demonstrate, hearing loss is associated with reduced quality of life as measured by difficulties with communication and impaired ADL and IADL, and reduced quality of life as measured by the SF-36. These findings highlight the need for improved methods of identifying individuals with age-related hearing loss and improving services for providing hearing aids, assistive listening devices, and auditory rehabilitation. Identifying individuals with hearing loss and supplying appropriate hearing aids or other listening devices and teaching coping strategies may have a positive impact on quality of life for older people.

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