The Relationship of Self-rated Vision and Hearing to Functional Status and Well-being Among Seniors 70 Years and Older

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• PURPOSE: To describe the relationship between self-reported visual and hearing impairment and an index of global functional status among seniors age 70 years or older.

• METHODS: A total of 7,320 United States community-dwelling persons aged 70 years or older participating in the 1993 Assets and Health Dynamics of the Oldest Old Survey (AHEAD) completed detailed questionnaires about their demographic, socioeconomic, and health status. Multivariate analyses of functional status (using a global index of functional status based on self-reported limitations in 11 activities) were conducted, controlling for demographic and socioeconomic status and common medical conditions, as well as independently for hearing and vision.

• RESULTS: Of the respondents, 27% rated their vision as fair or poor, whereas 25% rated their hearing as fair or poor. Controlling for demographic factors, socioeconomic status, medical conditions, and general health status, limitations in both vision and hearing correlated independently with worsened functional status. Controlling for income, wealth, and education did not greatly reduce the strength of the association between visual and hearing impairment and function.

• CONCLUSIONS: Visual and hearing impairment appear to have a significant relationship to overall functioning in the oldest old, regardless of income or wealth. By confirming these findings across income and household wealth groups, adjusted for medical conditions and general health status, in a nationally representative population of Americans age 70 years or older, this study provides a powerful added impetus to efforts for improving vision and hearing for all other Americans, including the oldest old. (Am J Ophthalmol 1999;127:447–452.

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THE LOSS OF VISION AND HEARING HAS BEEN ASSOCIated with important health decrements among older Americans.[1–4] Whether measured by visual acuity, "trouble seeing," "blurred vision," or by other terms, diminished vision has been associated with a greater rate of hip fractures,[1] loss of general functional status, well-being,[2–4] and vision-related functioning.[5–8] Similarly, loss of aural acuity has been associated with important decrements in health-related functioning and well-being.[6,9–11] Furthermore, poor hearing has been shown to correlate with a higher subsequent risk for nursing home placement and cognitive decline.[12,13]

However, only one previous study has been able to address the relationship between visual difficulties ("trouble seeing") and functioning, while explicitly adjusting for socioeconomic status, including detailed household income and wealth in a nationally representative population.[3] This study extends previous research in addressing the relationship of both self-rated vision and hearing to functioning and also explicitly adjusts for both as well as for personal and household income, wealth, and the educational disparities that may play a causal role in differences in the risk of poor functioning. This study also uses a large and detailed data set to provide more precise adjustments for general health status, comorbid medical status, and demographic factors for the fastest growing portion of our population—seniors age 70 years or older. As a result, this study provides a more complete assessment of the impact of difficulties with hearing and vision in this population than has been described previously.

METHODS

THIS STUDY IS BASED ON DATA FROM THE FIRST WAVE OF the Asset and Health Dynamics of the Oldest Old Survey

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(AHEAD), which includes 6,052 households in the United States with at least one individual aged 70 years or older in 1993. From these households, 8,223 individuals were surveyed. The current study eliminated spouses who were younger than 70 years, resulting in approximately 7,320 observations. The AHEAD sample is a national probability sample with a 2:1 oversampling of African-Americans, Hispanics, and residents of Florida. To guard against underrepresentation of the extremely disabled in an area sample, the AHEAD survey added a supplemental sample of respondents age 80 years or older from the Health Care Financing Administration's Medicare enrollment file.

The baseline AHEAD interview was conducted in 1993 using computer-assisted telephone interviews (CATI) for respondents aged 70 to 79 years and computer-assisted in-person interviews (CAPI) for persons age 80 years or older, although there was some variation in the interview mode within age groups.[14] The overall response rate was 81%. Individual interviews were obtained from both the age-eligible respondent (70 years or older) and the spouse, if any.

The survey interview included modules on demographic characteristics; economic resources and labor force activity; health status, functioning, and health care utilization and expenditures; and intergenerational transfers and family structure. As a result, the AHEAD study contains a comprehensive and detailed set of questions measuring household resources. Substantially improved wealth data were obtained by the use of bracketing techniques by which individuals who did not know or were unwilling to reveal specific dollar amounts in response to financial questions were prompted to provide upper or lower bounds of the amounts, resulting in a 75% reduction in item nonresponse among wealth holders and more accurate estimates of missing values.[15]

There is a growing body of literature addressing the complex manner in which various functional limitations are interrelated.[16–19] However, little consensus exists as to how or whether these measures should be combined into a single index. After the creation of similar indices in the literature,[20–22] we have created a global functional status index in which each activity, from advanced to basic activities of daily living, is given equal weight.

The primary outcome measure is an index of functional status score created on the basis of answers to 11 questions about the ability to perform a series of functional activities (Appendix). Respondents were asked a series of questions about various functional activities. First, they were asked whether they had any difficulty with each activity. If they answered yes, they were then asked whether they had a little difficulty or a lot of difficulty. Respondents could also report that they did not or could not perform certain activities. The series of questions varied for basic activities of daily living (ADLs) such as walking across a room, getting in or out of bed, dressing, bathing, eating, or toileting vs intermediate activities of daily living such as walking several blocks, climbing a flight of stairs, pulling or pushing large objects, lifting or carrying 10 lbs, or picking up a dime from a table. For basic ADLs respondents were first asked whether they needed help with each activity, to which they could respond "don't do." They were then asked whether they had any difficulty, even with help, and if so, how much difficulty. For intermediate ADLs, respondents were asked whether they had any difficulty with each activity, to which they could respond "yes," "no," "can't do," or "don't do." If they answered "don't do," they were then asked whether they were unable to perform the activity because of health. If they answered "yes," they were asked how much difficulty they had. The answers to each of the two series of questions for basic and intermediate ADLs were coded so that for each activity respondents were ranked on the following scale: 1 = no difficulty, 2 = a little difficulty, 3 = a lot of difficulty, 4 = can't do or don't do or don't do because of health.

A functional status index was created by adding up the responses and rescaling them to a 0 to 100 scale, with a value of zero implying no limitation in any activity and a higher score indicating worsened function. The mean score on the functional status index was 13.1, the SD was 15.4, and the range was 0 to 100, again with a higher score indicating worsened function. The Cronbach alpha for this index was 0.84.

All multivariate analyses were controlled for sex and age cohort (birth years, 1919 to 1923; 1914 to 1918; 1909 to 1913; and before 1903). Race was defined by the following categories: non-Hispanic African-American, Hispanic of any race, and white or other (86% of persons in this category were white; the rest included those who did not fall into the previous two categories). Within the Hispanic subgroup, most (approximately 59%) were Mexican-American. A Spanish version of the instrument was developed (Breslow M, unpublished data, presented at the annual meeting of the American Association for Opinion Research) and used in approximately 44% of the Hispanic sample. Marital status was measured by a series of dummy variables indicating each of the following categories: currently married (50%), living with a partner (1%), never married (3%), separated or divorced (5%), and widowed (41%). Educational attainment was defined by dummy variables indicating self-reports of 12 years or less of education (43%), some college (45%), college graduate (11%), and advanced professional education (physician, lawyer, PhD) (1%).

Measurement of household economic resources was made optimal in two ways in our analyses. First, a broad concept was used that measured both total household yearly income and wealth. Especially among the elderly who may not be actively employed, wealth may be a better measure of their command over economic resources than income.[23] In addition, the effect of socioeconomic factors

on health outcomes may be much stronger among poorer households. To accommodate these concerns, the data permitted a comprehensive definition of household wealth, including net equity in home, business, and real estate as well as a complete list of financial assets.[24] Second, we permitted a nonlinear relationship between functional status and economic resources and used a linear spline function for income and wealth. Such functions permit the estimation of different slopes over various ranges of the variable.[25] For wealth, different slopes were estimated within each of the following terciles: $0 to $47,700; $47,701 to $164,000; and $164,001 and over. For household income, we estimated slopes for the following terciles: $0 to $12,345; $12,346 to $23,270; and $23,271 and over. For heuristic purposes, these terciles can be thought of as dividing the population into the poor, the middle class, and the affluent, with the estimated slopes indicating the relationship between the economic and health variables over each of these segments. A lowering of the slope as one proceeds toward a higher tercile suggests a stronger relationship between economic status and health in the lower economic stratum.

This study focused on the relationship between self-reported vision and hearing and functional status. Respondents were asked to rate their vision (with spectacles if used) and hearing (with any hearing aid) on a scale of excellent, very good, good, fair, or poor. Four distinct variables were created to characterize each possible response to each of these questions, with the poor response being the omitted reference group.

Because the distribution of the functional status scores was bounded by zero and 100, with 13.7% of observations at zero (indicating optimal functioning for that person), functional status scores were estimated by a two-limit Tobit regression model, which explicitly recognizes that the outcome cannot be less than zero or more than 100.[26] For all models estimated in this study, the P value associated with the chi-square value of each equation was less than .0001, reflecting the large sample size. To provide an estimate of the potential clinical relevance, we conducted further analyses.

Both Tobit regression coefficients and adjusted standardized functional status scores are presented and were estimated as follows: For "white/other" respondents, rates and scores were predicted by taking the "white/other" sample and estimating the functional index score based on actual characteristics. For both African-American and Hispanic subsamples, adjusted scores were calculated by assigning each "white/other" observation actual socioeconomic characteristics but reassigning the race/ethnicity for each observation first to African-American and then to Hispanic. Scores were then estimated for each newly created observation with the assigned race/ethnicity and the original socioeconomic characteristics. Following this procedure, African-American and Hispanic sample scores were made standard, based on the socioeconomic and demographic characteristics of the "white/other" sample. All regressions were weighted to reflect the sampling frame of the survey. Furthermore, each multivariate analysis was estimated with and without a dummy variable, which indicated whether the interview was conducted face-to-face rather than by telephone; in no case was the coefficient for this variable significant.

TABLE 1. AHEAD Study Sample: Demographic and Health Characteristics (weighted means)

Characteristics	
Age (yrs) (±SD)	77.3 (5.8)
Female	60%
Married	50%
Education (not a high school graduate)	43%
African-American	10%
Hispanic	4%
Household income (median)	$18,215
Net worth (median)	$109,500
Chronic Conditions	
History of hypertension	50%
Current diabetes	13%
History of cancer	14%
Chronic lung disease	12%
Heart condition	32%
Heart attack within 5 years	7%
Angina	9%
Stroke	10%
Emotional or psychiatric problems	11%
Arthritis	25%
Hip fracture	5%
Urinary incontinence	19%
Other	31%

TABLE 2. AHEAD Population: Distribution of Responses to Questions About Self-reported Vision and Hearing Decrements

Response	Vision	Hearing
Excellent	12%	15%
Very good	26%	24%
Good	36%	36%
Fair	18%	19%
Poor	8%	6%
Blind	1%	—

RESULTS

TABLE 1 SHOWS THE DEMOGRAPHIC AND HEALTH CHARacteristics of the study population, and Table 2 illustrates the distribution of responses to the vision and hearing questions. The distribution of the functional status score (range, 0 to 100) was highly skewed. Although most

TABLE 3. Tobit Regression Coefficients and SEs for Health Factors Predictive of Functional Status Score

Health Factor	Coefficient (SE)
Vision	
Excellent	−5.68 (1.02)*
Very good	−4.42 (0.85)*
Good	−4.71 (0.79)*
Fair‡	−3.18 (0.83)*
Blind	5.99 (1.97)†
Hearing	
Excellent	−3.67 (1.01)*
Very good	−3.36 (0.93)*
Good	−3.35 (0.87)*
Fair‡	−3.17 (0.90)*
Self-reported General Health	
Excellent	−22.34 (1.06)*
Very good	−19.66 (0.83)*
Good	−15.66 (0.73)*
Fair‡	−9.67 (0.68)*
Medical Conditions	
Hypertension	0.41 (0.42)
Diabetes	1.79 (0.61)†
Cancer	1.12 (0.59)
Chronic lung disease	3.50 (0.63)*
Heart condition	0.37 (0.53)
Heart attack within 5 years	1.92 (0.84)§
Angina	2.12 (0.77)†
Stroke	8.60 (0.64)*
Emotional/psychiatric problems	1.56 (0.64)§
Arthritis	4.77 (0.48)*
Hip fracture	7.10 (0.89)*
Urinary incontinence	3.90 (0.51)*
Cataract surgery	0.46 (0.46)
Chronic pain	7.61 (0.47)*
Other major medical	

Controlling for age cohort, education, marital status, (nonlinear) income and wealth, general health, vision, and hearing.
Higher functional score = worse health.
*<.001.
†<.01.
‡Poor category was omitted.
§<.05.

TABLE 4. Mean Functional Status Scores* by Self-rated Quality of Vision and Hearing

	Unadjusted	Adjusted for Health and Demographics (age, race/ethnicity, and gender)	Adjusted for Health, Demographics, and Economic Status
Sight			
Excellent	5.21	8.84	9.02
Very good	6.86	9.29	9.68
Good	9.08	9.47	9.52
Fair	14.60	11.04	10.35
Poor	22.16	13.14	12.21
Hearing			
Excellent	7.17	9.46	9.75
Very good	8.46	9.66	9.92
Good	9.68	9.87	9.92
Fair	12.68	10.44	10.01
Poor	19.19	12.69	11.8

*Range: 0 to 100; higher scores = worse status.

respondents had excellent functioning and well-being (50th percentile score of 3), almost one fourth of those in the sample were significantly impaired (75th percentile score of 18). Similarly, whereas almost 40% of the respondents rated their vision or hearing as at least very good, slightly more than a one fourth rated their vision or hearing as either fair or poor.

Tables 3 and 4 demonstrate the significant relationships between decrements in hearing or vision on functioning and well-being. The two-limit Tobit regression analyses reveal that vision and hearing decrements, as rated by the respondents, are separately and independently related to marked decrements in functional status and well-being. For both vision and hearing, the extent of decreased functioning rises in response to deterioration in the self-rated quality of the sense function. The decrement associated with excellent self-rated vision compared with poor vision (the reference group) was comparable to the strength of the association between several important chronic conditions such as arthritis and worsened function. Furthermore, the relationship with vision and hearing persists, even after controlling for demographic and socioeconomic factors. As expected, increasing age, female gender, and lower economic status were all associated with lower function (coefficients not presented). Marital status and education were not associated with functional status.

Table 4 shows the mean functional scale scores: (1) unadjusted, (2) adjusted for health and demographics (age, race/ethnicity, and gender), and (3) adjusted for health, demographics, and socioeconomic status. Therefore, the adjusted scores in Table 4 demonstrate the strength of the relationship between visual or hearing impairment and functional status and the extent to which demographic and socioeconomic factors account for these differences. For example, the unadjusted scores of those with poor vision are four times worse than those with excellent sight, whereas those with poor hearing are two and one half times worse off than those with excellent hearing. The differences in functional status between those with the worst compared with the best self-rated vision and hearing decreases after controlling for demographic and socioeconomic factors, but they remain large.

DISCUSSION

OVER THE PAST FEW YEARS, REPORTS FROM MANY AUthors and many data sets have clearly shown the separate and significant impact of decreased vision and self-rated quality of vision in diminishing functional status and well-being, measured by a range of instruments.[1–8] Studies that examine the effect of hearing have also identified a marked effect of hearing loss, whether it is self-reported or measured audiometrically.[6,9–13] In studies examining the effects of both hearing and vision loss, investigators have found that uncorrected sensory deprivation is associated with both a lower quality of life and greater dependency.[27,28]

In two other studies that looked at both senses as independent factors, one found that both were independently related to functional deficits,[6] whereas the other did not.[2] As a result, this study extends our understanding of the relative independent effects of hearing and vision deficits in a nationally representative population of older Americans (age 70 years and older), finding that both are independently related to functional deficits, albeit with a lesser influence for hearing impairment (confirming the results of the earlier study of Laforge and associates, which was conducted in the Cleveland metropolitan area).[6] Both this study and the Cleveland study differ from the study by Lee and associates, which analyzed the Medical Outcomes Study longitudinal panel, in the nature of the populations studied.[2] Unlike the Medical Outcomes Study panel, which had a young cohort, this study and the Cleveland study focus on older Americans, indicating the increasing prominence of hearing difficulties in older populations; such a prominence is further confirmed in the studies of Appollonio and associates of the community-dwelling elderly in Italy[28] and the population 72 years and older studied by Tinetti and associates.[27]

This study also extends our understanding by providing analyses that include detailed and explicit data on socioeconomic status, including income and wealth within the modeling. Income and wealth have been found to have a marked independent relationship to functional status in older populations.[22,29] None of the earlier studies, which examined the effects of hearing and vision independently, included detailed medical conditions and explicit, detailed data on income and wealth in the analyses. As a result, that functional deficits persist across income and household wealth groups when adjusted for medical conditions and general health status suggests the importance and universality of the findings. Furthermore, the finding that economic adjustment had little to add compared with the adjustments for health conditions and demographic variables (Table 3) illustrates the universality of vision and hearing concerns across socioeconomic groups, confirming and extending the findings of an earlier study by Kington and associates[3] involving younger seniors. This study also included detailed economic data examining the relationship between vision loss and functional deficits.

The results of the current study, which report the separate, independent effects of self-rated quality of vision and hearing in a nationally representative population (overall sample size, 7,114) of older Americans (mean age, 77 years and older), provide strong additional evidence of the importance of addressing vision and hearing impairments in this population. The results of this study make it clear that improving vision and hearing may result in marked improvements in functioning and health status.

The extent of the differences in the functioning and well-being index scores between excellent and poor vision or hearing is quite large. In terms of the magnitude of effect, the unadjusted scores are more than five times greater than the magnitude of effect of race, whereas even the adjusted difference in scores between excellent and poor vision is greater than the unadjusted magnitude of race. Therefore, the effects of decrements in vision and hearing are large in meaningful ways.

Because this study did not include medical or ocular examinations, we cannot relate the presence or absence of a treatable condition, or even the presence or absence of a disease, to the findings. As a result, we cannot state the unique effects of cataract, glaucoma, or sensorineural hearing loss relative to functioning and well-being. However, this study does indicate the possibly more important notion of the patient's perception of his or her own quality of vision or hearing to functioning and well-being. Even when controlled for the presence of other medical conditions, self-rated general health status, other symptoms, and the influence of education, marital status, and income and wealth, persons who thought their own vision or hearing was only fair or poor also reported markedly worse functional status. As a result, regardless of the degree of overall medical morbidity or poverty or wealth, those who rated their own hearing as fair or poor or those with any decrement of vision (that is, other than excellent) fared worse than those with a better quality of vision or hearing. The lack of association in Table 3 between having had cataract surgery suggests that the mere fact of having surgery is not significant, it is how the patient subsequently perceived his or her vision.

The importance of self-rated vision or hearing to patient well-being can also be seen in the reports of the satisfaction of patients with their vision and their health care in studies done after cataract surgery and after refractive surgery; for example, self-rated vision after refractive surgery was strongly and significantly related to overall satisfaction with radial keratotomy.[30]

By phrasing the question in terms of patient-centered factors and issues, the study data set enables us to examine directly the importance of vision and hearing on functioning and well-being, as opposed to using an intermediary condition or disease surrogate. Because recent studies have associated self-rated functional status and well-being with

higher subsequent morbidity, mortality, and resource utilization, the connection between poorer self-rated states of vision and hearing with poorer functional status reinforces the findings of previous studies that reductions in vision and hearing are associated with poorer ultimate health outcomes.[6,10] By providing confirmation of these findings adjusted for other medical conditions and general health status, across income and household wealth groups, in a nationally representative population of Americans age 70 years or older, this study provides powerful, additional impetus to efforts for improving vision and hearing for all older Americans, including the oldest old.

APPENDIX

ACTIVITIES ASSESSED IN FUNCTIONAL STATUS INDEX

- Walk across a room
- Dress, including putting on shoes and socks
- Bathe or shower
- Eat
- Get in and out of bed
- Use of toilet
- Walk several blocks
- Climb a flight of stairs
- Pull or push large objects such as a living room chair
- Lift or carry weights of more than 10 lbs, such as a heavy bag of groceries
- Pick up dime from a table

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