THE ASSOCIATIONS BETWEEN SELF-RATED VISION AND HEARING AND FUNCTIONAL STATUS IN MIDDLE AGE

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ABSTRACT

Objectives: To describe the correlations between self-reported visual and hearing impairment and an index of global functional status

Design: Multivariate analyses of functional status based on cross sectional data from Wave 1 (1992) of the Health and Retirement Study (HRS) controlling for demographic and socioeconomic status, common chronic conditions and general health status.

Participants: 9,744 U.S. community-dwelling persons age 51-61 years

Main Outcome Measure: A global index of functional status based on self-reported limitations in 11 activities

Results: About 12% of respondents rated their vision or hearing as poor. Controlling for demographic factors, socioeconomic status, medical conditions, and general health status, limitations in both vision and hearing were independently correlated with worse functional status. Controlling for income, wealth, education did not greatly reduce the strength of the associations between vision and hearing impairment and function.

Conclusions: Visual and hearing impairment appear to have a significant relationship with overall physical functioning in the elderly.

INTRODUCTION

The loss of vision and hearing have been associated with significant health decrements among older Americans(1-4). Whether measured as visual acuity, “trouble seeing,” “blurred vision,” or other terms, diminished vision has been associated with a greater rate of hip fractures(1), loss of general functional status and well-being (2-4), and vision-related functioning(5-8). Similarly, loss of hearing acuity has been associated with important decrements in health-related functioning and well-being(6,9-11). Further, poor hearing has been correlated with a higher subsequent risk of requiring nursing home placement and cognitive decline(12,13).

Only one prior study, however, has been able to address the relationships between vision difficulties (“trouble seeing”) and functioning while explicitly adjusting for socioeconomic status including detailed household income and wealth in a nationally representative population(2). This study extends previous research in addressing the relationships of both self-rated vision and hearing to functioning while also explicitly adjusting for each other as well as for the personal and household income, wealth, and education disparities that may play a causal role in differences in risk of poor function. In addition, this study uses a unique dataset to provide detailed adjustments for general health status, co-morbid medical status, and demographic factors for persons in late middle age. As such, it provides a more complete assessment of the impact of hearing and vision difficulties in this population than has been previously described. The study builds on the work of a related analysis of national data on persons above age 70(14).

METHODS

Data Overview

This study uses data from Wave I (1992) of the Health and Retirement Survey (HRS), funded by the National Institute on Aging(15). The HRS is a national probability sample of 12,654 men and women ages 51-61 in 1992 and their spouses in 7,700 households with a 2:1 over-sampling of African-American and Hispanic persons and over-sampling of residents of Florida. The overall response rate was 81%. Our analyses were restricted to the 9,744 respondents and spouses between ages 51 and 61. Approximately 2,804 spouses whose ages were outside the specified range were eliminated. The data were obtained by in-person home interviews of respondents and spouses. Substantially improved wealth data were obtained by use of bracketing techniques by which individuals who did not know or were not willing to reveal specific dollar amounts in response to financial questions were prompted to provide upper and/or lower bounds on the amounts, resulting in a 25% reduction in non-response among wealth holders(16).

VARIABLE DEFINITIONS

Outcome Variables

There is a growing literature addressing the complex manner in which various functional limitations are interrelated(17-20). However, there is little consensus as to how or whether these measures should be aggregated into a single index. Following the creation of similar indices in the published literature(21-23), we have created a global functional status index in which each activity, from advanced to basic activities of daily living, is given equal weight.

A functional status score was created based on the answers to 17 questions about the ability to perform a series of functional activities (See Table A in the Appendix for list of specific activities). Respondents could answer one of the following options: 1) not at all difficult, 2) a little difficult, 3) somewhat difficult, and 4) very difficult/can't do. A functional status index was created by summing responses to all who answered 1-4 and rescaling to a 0-100 scale, with a value of zero implying no

limitation in any activity and a higher score indicating worse function. The mean score on the functional status index was 13.1, the standard deviation was 15.4, and the range was 0-100, with a higher score indicating worse function. The Cronbach alpha(24) for this index was 0.89 in this sample.

Explanatory Variables

All multivariate analyses controlled for sex and age cohort (birth years 1931-1934, 1935-1937, and after 1937). Race and ethnicity were defined by the following categories: non-Hispanic African-American, Hispanic of any race, and white/other.

Within the Hispanic sub-group, the majority (approximately 60%) were Mexican American. Marital status was measured by a series of dummy variables indicating each of the following categories: currently married, living with a partner, never married, separated, divorced, and widowed. Educational attainment was defined by dummy variables indicating self-reports of twelve years or fewer of education, some college, college graduate, and advanced professional education (physicians, lawyer, Ph.D.'s).

Measurement of household resources was improved in two ways in this study. First, a broader concept was employed by measuring both total household yearly income and wealth and second, we permitted non-linear relationship. The data permit a comprehensive definition of household wealth including net equity in home, business, and real estate as well as a complete list of financial assets(16). To estimate correlations with income and wealth, we created piece-wise linear spline functions, which permit estimation of different slopes over different ranges of the variable(non-linear variant)(25). For wealth, different slopes were estimated within each of the following terciles: $0 to $50,000; $50,000 to $164,100; and $164,100 and above. For household income, we estimated slopes for the following terciles: $0 to $25,656; $25,656 to $50,000; and $50,000 and above. For heuristic purposes, we can think of these terciles as dividing the population into the poor, the middle class and the affluent, with the estimated slopes telling us the relationships between the economic and health variables over each of these segments. A lowering of the slope as one proceeds to a higher tercile suggests a stronger relationship between economic status and health in lower economic strata.

The focus of this paper is the relationship between self-reported vision and hearing and functional status. Respondents were asked to rate their vision (with glasses if used) and hearing (with hearing aid if used) on a scale of excellent, very good, good, fair, and poor. Four dummy variables were created to characterize responses to these two questions with the “poor” response as the reference group. We also included a dummy variable indicating a person reported being legally blind.

Statistical Analysis

Because the distribution of the functional status score was bounded by 0 and 100 with a large percentage of observations at 0 (13.7%), functional status scores were estimated by a two-limit Tobit regression model(26). For all models estimated in this paper, the p value associated with each equation's chi-square value was less than 0.0001.

Both Tobit regression coefficients and functional status scores are presented. For "white/other" respondents, rates and scores were predicted by taking the "white/other" sample and estimating the mean prevalence rate and functional index score based on their actual characteristics. For both African-American and Hispanic sub-samples, adjusted scores were calculated by assigning each "white/other" observation their actual socioeconomic characteristics but re-assigning the race/ethnicity for each observation first to African American and then to Hispanic. Rates and scores were then estimated for each newly created observation with their assigned race/ethnicity and their original socioeconomic characteristics. By following this procedure, African-American and Hispanic sample rates and scores were standardized based on the socioeconomic and demographic characteristics of the "white/other" sample. All regression were weighted to reflect the sampling frame of the survey.

Both Tobit regression coefficients and adjusted standardized functional status scores are presented. Scores 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 their actual characteristics. For both African-American and Hispanic sub-samples, adjusted scores were calculated by assigning each "white/other" observation their actual socioeconomic characteristics but re-

assigning the race/ethnicity for each observation first to African American and then to Hispanic. Scores were then estimated for each newly created observation with their assigned race/ethnicity and their original socioeconomic characteristics. By following this procedure, African-American and Hispanic sample scores were standardized based on the socioeconomic and demographic characteristics of the "white/other" sample. All regression were weighted to reflect the sampling frame of the survey. Furthermore, a each multivariate analysis was estimated with and without a dummy variable indicating that the interview was conducted face-to-face rather than by telephone. In no case was the coefficient for this variable significant (results not presented).

RESULTS

Table 1 presents the demographic and health characteristics of the study population. Table 2 illustrates the distribution of responses to the vision and hearing questions. While most respondents reported excellent to good vision or hearing, about 12% rated their vision or hearing only fair or poor.

Tables 3 and 4 demonstrate the significant relationship 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 respondents, are uniquely related to significant decrements on functional status and well-being. For both vision and hearing, the extent of decreased functioning rises with deterioration in the self-rated quality of the sense function. The decrement associated with excellent self-rated vision compared to poor (the reference group) was comparable to the strength of the association between several important chronic conditions such as arthritis and worse function. Furthermore, the relationships with vision and hearing persisted even after controlling for demographic and socioeconomic factors. Female gender, being currently married, and lower economic status were associated with worse function (sociodemographic coefficients not presented). Within this sample, age and education were not associated with functional status.

The adjusted scores presented in Table 4 also 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 sight score were about 3.6 times worse than those with excellent sight, while those with poor hearing are 2.25 times worse off than those with excellent hearing. The differences in functional status between those with the worse versus the best self-rated vision and hearing decrease after controlling for demographic and socioeconomic factors but remain large. After controlling for both sociodemographic and economic factors, the functional status scores of those with poor vision is reduced to about 1.6 times that of persons with excellent vision, while the score for those with poor hearing is reduced to 1.3 times that of persons with excellent hearing.

DISCUSSION

Over the last few years, reports from many authors and many datasets have clearly shown the unique and significant impact of decreased vision and self-rated quality of vision in diminishing functional status and well-being, as measured by a range of instruments(1-8). Studies examining the effect of hearing have similarly identified a significant effect of hearing loss, whether self-reported or measured audiometrically(6,9-13). Many studies that have examined both hearing and vision have combined them into one variable, making it impossible to sort out the independent effect of each. In two studies that looked at both senses as independent factors, one found that both were independently related to functional deficits(6) while another did not(2). Thus, the current study further extends our understanding of the relative independent effects of hearing and vision deficits in a nationally representative population of middle aged Americans (age 51-61), finding that both are independently related to functional deficits, albeit with a lesser influence for hearing impairment (confirming the results of the prior study of Laforge, et al, conducted in the Cleveland area(6). Both this and the Cleveland study differs from the study by Lee, at al, analyzing the Medical Outcomes Study longitudinal panel(2), in the nature of the populations studied. Unlike the mostly younger cohort of the Medical Outcomes Study panel, the current study and the Cleveland study focus on older Americans, indicating the increasing prominence of hearing difficulties in older populations.

This study also extends our understanding in providing analyses that include detailed and explicit data socioeconomic status, including income and wealth within the modeling. Income and wealth have been found to have significant independent relationships with functional status in older populations(23,24). In none of the prior studies which examined the effects of both hearing and vision independently were detailed medical conditions and explicit, detailed data on income and wealth included in the analyses. Thus, the finding that functional deficits persist across income and household wealth groups, adjusted for medical conditions and general health status, suggests the importance and universality of the findings. Further, the finding that economic adjustment had little to add compared to the adjustments for health conditions and demographic variables (columns 3 vs. 2 in Table 3) illustrates

the universality of vision and hearing concerns across socio-economic groups. This result confirms and extends the findings found in a prior study by Kington, et al, with detailed economic data examining the relationships between vision loss and functional deficits(3).

The results of the present study, which report the unique, independent effects of self-rated quality of vision and hearing in a nationally representative population of middle aged Americans (age 51-61), provide strong additional evidence of the importance of addressing vision and hearing impairments in this population. With the results of this study, it is clear that improving vision and improving poor hearing may result in significant improvements in functioning and health status.

The extent of the functioning and well-being index score differences between excellent vision or hearing and poor vision or hearing is quite large. In terms of the magnitude of effect, the unadjusted scores are more than 5 times greater than the magnitude of effect of race, while even the adjusted score difference between excellent and poor vision remains greater than the **unadjusted** magnitude of race.

The study did not include medical or ocular examinations. As such, we cannot relate the presence or absence of a treatable condition, or even the presence or absence of a disease, to the findings presented in this study. Thus, we cannot state the unique effects of cataract, or of glaucoma, or of sensori-neural hearing loss, relative to functioning and well-being. However, this study does relate the, perhaps, even 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 significantly worse functional status. Thus, regardless of the degree of overall medical morbidity, or of poverty or wealth, persons who rated their own hearing fair or poor, or those with any decrement of vision (i.e., other than "excellent") fared worse than those with better quality of vision or hearing.

The importance of self-rated vision or hearing to patient well-being can also be seen in the reports on patient satisfaction with their vision and their health care in studies done on patients 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(25).

By phrasing the inquiry in terms of patient-centered factors and issues, the study dataset allows us to directly examine the importance of vision and hearing on functioning and well-being, as opposed to using an intermediary condition or disease surrogate. Since recent studies have related self-rated functional status and well-being to subsequent higher morbidity, mortality, and resource utilization, the connection between poorer self-rated states of vision and hearing to poorer functional status reinforces the findings of prior studies that reductions in vision and hearing are associated with poorer ultimate health outcomes(6,10). By providing confirmation of these findings across income and household wealth groups, adjusted for other medical conditions and general health status, in a nationally representative population of Americans 51-61 years old, this study provides powerful, additional impetus to efforts to improve vision and hearing for all Americans.

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TABLE A

Appendix

Activities Assessed in Functional Status Index

1. Run or jog a mile
2. Walk several blocks
3. Walk one block
4. Walk across a room
5. Sit for about 2 hours
6. Get up from chair after sitting for long periods
7. Get in and out of bed without help
8. Climb several flights of stairs without resting
9. Climb one flight of stairs without resting
10. Lift or carry weights over 10 lbs., like heavy bag of groceries
11. Stoop, kneel, or crouch
12. Pick up a dime from a table
13. Bathe or shower without help
14. Reach or extend arms above shoulder level
15. Pull or push large objects like a living room chair
16. Eat without help
17. Dress without help

TABLE 1

HRS Study Sample

Demographic and Health Characteristics

N=9744

(weighted means)

DEMOGRAPHIC CHARACTERISTICS	
Age (±SD)	55.89 (±2.80)
Female	53%
Married	75%
Education (< High School Graduate)	25%
African American	12%
Hispanic	6%
Household Income (median)	$39,000
Net Worth (median)	$110,000
CHRONIC CONDITIONS	
Hypertension (ever)	38%
Diabetes (ever)	10%
Cancer (ever)	6%
Chronic Lung Disease	8%
Heart Condition	13%
Heart Attack within 5 years	6%
Angina	4%
Congestive Heart Failure	2%
Stroke (ever)	3%
Emotional/Psychiatric Problems	11%
Arthritis	38%

TABLE 2

Distribution of Self-Reported Vision and Hearing

HRS Population

VISION AND HEARING DECREMENTS		
	Vision	Hearing
Excellent	30%	30%
Very Good	31%	28%
Good	28%	28%
Fair	9%	11%
Poor	3%	2%
Blind	.01%	—

TABLE 3

Tobit Regression Coefficients and Standard Errors for Health Factors Predicting Functional Status Score

VISION	
Excellent	-9.09 (0.89) [xxx]
Very Good	-8.87 (0.88)[xxx]
Good	-8.44 (0.87)[xxx]
Fair[1]	-5.16 (0.93)[xxx]
Blind	27.7 (16.16)
HEARING	
Excellent	-5.02 (0.93)[xxx]
Very Good	-4.21 (0.93)[xxx]
Good	-4.05 (0.92)[xxx]
Fair[1]	-1.37 (0.96)
SELF-REPORTED GENERAL HEALTH	
Excellent	-13.10 (0.70)[xxx]
Very Good	-11.79 (0.65)[xxx]
Good	- 9.15 (0.63)[xxx]
Fair[1]	- 2.58 (0.64)[xxx]
MEDICAL CONDITIONS	
Hypertension	0.95 (0.29)[xxx]
Cancer	1.09 (0.59)
Chronic Lung Disease	5.57 (0.50)[xxx]
Diabetes	1.93 (0.46)[xxx]

TABLE 3 (cont.)

Tobit Regression Coefficients and Standard Errors for Health Factors Predicting Functional Status Score

MEDICAL CONDITIONS (CONT.)	
Heart Condition	1.90 (0.56)^{xxx}
Heart Attack within 5 years	-0.39 (0.77)
Angina	5.86 (0.84)^{xxx}
Congestive Heart Failure	5.06 (1.18)^{xxx}
Stroke	9.37 (0.86)^{xxx}
Emotional/Psychiatric Problems	4.45 (0.45)^{xxx}
Arthritis	6.78 (0.29)^{xxx}

[1] omitted category: poor

Controlling for: age cohort, education, marital status, (nonlinear) income and wealth, missing general health, missing vision, missing hearing.

Higher Functional Score = Worse health

^{xxx} <0.001

^{xx} <0.01

^{x} <0.05

TABLE 4.

Mean Functional Status Scores[1] by Self-Rated Quality of Vision and Hearing

	Unadjusted	Adjusted for Health, Age, Race/Ethnicity, and Gender	Adjusted for Health, Demographics, and Economic Status
SIGHT			
Excellent	9.21	12.66	13.07
Very Good	10.66	12.93	13.24
Good	14.30	13.75	13.56
Fair	22.38	17.53	16.16
Poor	33.40	25.35	20.62
HEARING			
Excellent	9.97	12.65	12.98
Very Good	11.42	13.47	13.59
Good	13.87	13.85	13.71
Fair	19.72	17.15	15.82
Poor	22.55	18.75	16.94

[1] Range: 0 - 100; Higher scores = worse status.