

Double Jeopardy: The Effects of Comorbid Conditions among Older People with Vision Loss

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Abstract: This retrospective study used national survey data to examine multiple effects of nine comorbid conditions—breathing problems, depression risk, diabetes, heart problems, hearing impairment, hypertension, joint problems, low back pain, and stroke—on physical functioning, participation, and health status among older adults with visual impairments. Bivariate and multivariate procedures were used to compare older adults who had neither visual impairment nor these conditions with adults of similar age who had one of the nine conditions only, visual impairment only, or both visual impairment and the condition. Findings indicate that older adults with visual impairment frequently experience comorbid conditions, and that these conditions are associated with difficulties in walking and climbing steps, shopping, and socializing, and with significantly more self-reports of declining health. Results suggest that interventions by health care and mental health providers, as well as enhanced rehabilitation services, have the potential to reduce or prevent the deleterious effects of comorbid conditions.

Vision loss is a fairly common experience for older people. In an examination of the 1994 Supplement on Aging, Campbell, Crews, Moriarty, Zack, & Blackman, (1999) found that 18.1% of people aged 70 and older reported blindness in one eye, blindness in both eyes, and trouble seeing even when wearing glasses (Campbell et al., 1999). In the United States, aging is associated with the leading causes of vision loss (Iezzoni & O'Day, 2006), and the population of people experiencing vision loss

is expected to increase in the coming decades (Congdon et al., 2004).

The effects of vision loss may compromise the ability to read, drive a car, and conduct personal affairs. These effects are well documented elsewhere (Crews & Campbell, 2004; Knudtson, Klein, Klein, Cruickshanks, & Lee, 2005; Lin et al., 2004; Raina, Wong, & Massfeller, 2004; Salive et al., 1994; West et al., 2002). Of greater concern than performing daily tasks, however, is the effect of vision loss on social roles, and participation in other civic and social relationships. For many older people, vision loss occurs when other health conditions begin to affect daily functioning and social participation.

Disclaimer: The findings and conclusions in this introduction are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

As people with disabilities age, they are more likely to develop “comorbid conditions” (using the public health definition of health conditions that occur simultaneously, similar to what is sometimes referred to in vision rehabilitation as “secondary conditions”) that can seriously affect their daily functioning and health status (Harrison, 2006). Recent research has explored the occurrence and consequences of comorbid conditions among older people with vision loss. Vision impairment is associated with higher prevalence of hip fracture (Cummings et al., 1995; Felson et al., 1989), depression (Brody et al., 2001; Rovner & Ganguli, 1998), cognitive decline (Lin et al., 2004), arthritis (Nevitt, Cummings, Kidd, & Black, 1989), falls (Dunlop et al., 2005), and mortality (Wang, Mitchell, Simpson, Cumming, & Smith, 2001).

The presence of multiple health conditions in combination with vision loss generally appears to compromise functional capacity. The interaction, for example, of vision loss and hearing loss leads to substantial decrements in the performance of activities and social roles (Crews & Campbell, 2004; Kempen, Verbrugge, Merrill, & Ormel, 1998). Indeed, this phenomenon of visual impairment propelling the disabling effect of comorbidities has also been described on a population basis in the National Health Interview Survey (NHIS) (Verbrugge, Lepkowski, & Imanaka, 1989).

Previous research has examined combinations of conditions in conjunction with vision loss to characterize a variety of outcomes. Here, we want to conduct a broader examination of the effects of comorbid conditions as they influence func-

tioning and health by examining nine pairs of conditions that commonly occur among people who are older and report vision loss. Our aim is to stimulate additional inquiry into the importance of these combinations as they potentially affect practice (evaluation, measurement, and clinical interventions) and policy (social and economic costs as well as the development of health and public health interventions).

Methods

RESEARCH QUESTIONS

This investigation was designed to address three salient questions. First, what is the estimated population of older people experiencing vision impairment and selected comorbid conditions? Second, how does the presence of a commonly occurring comorbid condition affect functioning, participation, and health status among older adults with visual impairment? Finally, which commonly occurring comorbid conditions are most likely to have negative effects on functioning, participation, and health status in this population?

Nine conditions—diabetes, hypertension, heart problems, joint symptoms, low back pain, hearing impairment, stroke, depression, and breathing problems—were selected because they are relatively common among older adults and most lend themselves to prevention or treatment. Each of these conditions was examined in combination with vision loss to illustrate their effects on five outcome measures: walking, climbing stairs, shopping, socializing, and self-reported health status (better, worse, or about the same as a year ago). These activity and participation indicators were selected as representative elements of the International Classification of Functioning, Disability, and

Health (ICF) (World Health Organization, 2001). Disability is described in the ICF as an interplay among body functions and structures, activities, and participation, mediated by environmental and personal factors. Walking and climbing stairs are representative of activity measures, and shopping and socializing are representative of participation (Crews, 2003).

DATA SOURCE

The NHIS is a nationally representative survey of the noninstitutionalized civilian population living in the United States (Jones & Beatty, 2003; Jones & Bell, 2004). It is conducted annually by the U.S. Census Bureau and the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention, to gather health-related information on households and individuals. The NHIS has been used widely by health services researchers to address issues of chronic disease, health status, health risks, and disability. Since 1997, the NHIS has contained a Sample Adult Core component, in which one self-responding adult is selected from each surveyed household to participate in the Sample Adult part of the survey.

We focused our investigation on data collected from the 30,000 or more Sample Adults selected in each year of the survey, rather than the total population of adults and children in the NHIS, because the Sample Adult Core contains specific information on chronic conditions not found in other survey components for adults. We targeted data from the years 1997–2004, because the survey design was basically the same for these years. We downloaded data files and documentation from the Internet (National Center for Health Statistics, n.d.). We selected

questions of interest that were asked of all Sample Adults for each of the eight years of the survey. Box 1 lists the survey questions in the Sample Adult Core associated with our targeted variables for this study. We developed a variable crosswalk (a table containing the construct being measured, the name of the variable in the data set that was associated with the construct, and the values and labels for each variable of interest for each year of the survey) for all variables of interest to ensure that each selected variable measured the same construct across years, by identifying target variables in the codebooks for each year of interest. We imported our Sample Adult data into SPSS 12.0 for Windows (SPSS, 2003), creating one data file for each year from 1997 through 2004. We kept only target variables in each file, recoding names where necessary, and verifying that all variable values measured the same construct in each individual file, to ensure parity across files. After ensuring that each of our eight Sample Adult files was identical in content to all other files, we merged the files, using recommended NCHS procedures. We chose to combine the survey years to circumvent the problem of small cell sizes that commonly plagues disability research.

ANALYTICAL PROCEDURES

We divided the Final Annual Weight for the Sample Adult files by eight (the number of survey years in our combined database) to provide accurate population estimates for our combined sample. We analyzed data from the combined Sample Adult files to examine the effects of visual impairment (blindness or serious difficulty seeing with glasses) and the

nine comorbid conditions on measures of activity, social participation, and physical health status for adults age 65 years and older. We used bivariate procedures (crosstabulation) and multivariate procedures (logistic regression) for dichotomous dependent variables. For the health status and depression risk outcome measures that had more than two categories, we fit generalized logit models, using the same independent predictors that were used in our logistic modeling.

Due to the complex stratified cluster sampling design employed by the NHIS, we used SUDAAN 9.0 (Research Triangle Institute, 2005; Shah, Barnwell, & Bieler, 1997) for all data analyses, to take into account the multi-stage cluster design of the survey, when computing standard errors and tests of statistical significance. In both bivariate and multivariate analyses, we tested for main effects of visual impairment and each comorbid condition and for interactive effects of visual impairment and each comorbid condition. In all multivariate procedures, we adjusted our odds ratios for age, race/ethnicity, and sex. We had a total of 49,278 adults age 65 years and older in our sample. This group served as the denominator for all analyses.

Definition of visual impairment

We used the summary variable in the data files for visual impairment constructed by NCHS as our measure of visual impairment for this study. (People with either serious difficulty seeing with glasses or not being able to see at all were included in this variable.) A total of 8,787 respondents (17.3% of older adults) identified themselves as having a visual impairment.

Definitions of comorbid conditions

We identified comorbid conditions through discrete condition questions or summary variables that combined several conditions into a larger category. (See Box 1 for a list of survey questions on chronic conditions.) We identified adults as having diabetes if they had been told by a doctor that they had diabetes. Adults with hypertension, stroke, measures of heart disease (including coronary heart disease, angina, and myocardial infarction), and breathing problems (including asthma, emphysema, and chronic bronchitis) were also identified via medical diagnoses. Hearing impairment was defined by self-reports of a little or a lot of trouble hearing or of deafness. Joint problems included respondents who said that they regularly had pain and swelling in their joints during the year. Adults were counted as having low back pain if they had experienced the condition for three months or more during a given year. We defined depressive symptoms as risk for depression (mild/moderate, severe, no risk) based on responses to survey questions derived from the K6 Scale (Andrews & Slade, 2001; Department of Human Services Centre for Population Studies in Epidemiology, 2002; Furu-kawa, Kessler, Slade, & Andrews, 2003; Kessler et al., 2002; National Comorbidity Survey, n.d.; Strine et al., 2005). The K6 Scale includes feelings—of sadness, hopelessness, nervousness, restlessness, worthlessness, and everything being an effort—that significantly interfered with the respondent's daily activities during the past 30 days. These variables were reverse-coded and summed across scores (unweighted) for each adult (Department of Human Services Centre for Population Studies in Epidemiology, 2002; National

Questions on health conditions from the National Health Interview Survey on Disability, Health Status, and Chronic Conditions

Have you ever been told by a doctor or other health professional that you had

Hypertension, also called high blood pressure?

Coronary heart disease?

Angina, also called angina pectoris?

A heart attack, also called myocardial infarction?

Any kind of heart condition or heart disease, other than the ones just listed above?

A stroke?

Emphysema?

Asthma?

Have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes?

During the past 12 months, have you been told by a doctor or other health professional that you had chronic bronchitis?

During the past 12 months, have you had pain, aching, stiffness or swelling in or around a joint?

During the past three months, did you have low back pain?

Hearing and Vision Questions

Which statement best describes your hearing (without a hearing aid): good, a little trouble, a lot of trouble, deaf?

Do you have any trouble seeing, even when wearing glasses or contact lenses?

Mental Health Questions

During the past 30 days, how often did you feel so sad that nothing could cheer you up, nervous, restless or fidgety, hopeless, that everything was an effort, worthless?

All of the time

Most of the time

Some of the time

A little of the time

None of the time

Health Status and Functional Limitation Questions

Compared with 12 months ago, would you say your health is better, worse, or about the same?

By yourself, and without using any special equipment, how difficult is it for you to walk a quarter of a mile—about 3 blocks? Walk up 10 steps without resting? Go out to things like shopping, movies, or sporting events? Participate in social activities such as visiting friends, going to clubs and meetings, going to parties?

Not at all difficult

Only a little difficult

Somewhat difficult

Very difficult

Can't do at all

Box 1.

Comorbidity Survey, n.d.; Strine et al., 2005).

In both the bivariate and multivariate analyses, we examined our dependent measures for adults age 65 and older who reported having or not having a visual impairment, for adults who had a chronic condition, and for adults with and without visual impairment who reported having at least one comorbid condition.

DEPENDENT MEASURES

Five different dependent measures were examined for each subgroup in the sample. Measures of activity limitation included level of difficulty walking a quarter-mile and level of difficulty climbing 10 steps without resting. Measures of participation included level of difficulty shopping and level of difficulty participating in social events with friends and family. Difficulty categories included “not at all difficult,” “only a little difficult,” “somewhat difficult,” “very difficult,” and “can’t do at all.” We categorized “mild difficulty” as respondents who reported that the activities were “a little” or “somewhat” difficult. Respondents who reported that the activities were “very difficult” but that they could still do them were categorized as having “moderate difficulty,” and respondents who could not do the activities were identified as having “severe difficulty.” Difficulty levels were combined into no/mild and moderate/severe to maximize our cell sizes in the analyses, as we examined the severity of these limitations. We measured health status by self-reported ratings of having health that was better, worse, or about the same as a year ago. In our multivariate analyses, respondents reporting that they had neither visual impairment nor a chronic condition, those

who had no/mild difficulty with the functional limitation and participation measures, and those who said that their health status remained the same over the past 12 months served as our reference groups.

Results

COMMONLY OCCURRING COMORBID CONDITIONS

Table 1 addresses our first research question by summarizing the prevalence of nine conditions among older people generally as well as the prevalence of these conditions as they occur in conjunction with vision loss. People with vision loss were more likely to report each of the nine conditions. While we cannot be certain about the causal pathway for these conditions, some, like diabetes and stroke, are likely to contribute to vision loss; others, like depression, may result from vision impairment. The numbers of people who experienced vision impairments and comorbid conditions were substantial. Of the total estimated population of 5.7 million older people with vision loss, 3.3 million were at risk for mild or moderate depression, and 350,000 were at risk for severe depression. Some 1.2 million people reported both vision loss and diabetes, and almost 900,000 reported both stroke and vision loss.

Tables 2–10 show the relation of each of the nine comorbid conditions to the outcome measures: walking, climbing stairs, shopping, socializing, and changes in health status over the past year. For each of the nine conditions, we show the outcome measures for four groups: 1) people without vision loss and without the condition of concern, and those who reported 2) vision loss only, 3) the comorbid condition only, and 4)

Table 1
Chronic conditions among all adults 65 years and older, and comorbid conditions with visual impairment among adults 65 and older.

Condition	Vision impairment + comorbid chronic condition				Chronic condition for all age 65+			
	Unweighted N	Estimated population ^a	%	95%CI	Sample N	Estimated population	%	95%CI
Breathing problems	1,865	1,198,802	21.0	±0.9	7,411	4,914,417	14.9	±0.4
Depression risk								
Mild/moderate	5,073	3,260,398	57.2	±1.3	21,824	14,359,364	43.5	±0.7
Severe	578	350,644	6.2	±0.6	1,374	832,782	2.5	±0.2
No risk	3,136	2,087,194	36.6	±1.3	26,080	17,824,474	54.0	±0.7
Diabetes	1,940	1,243,178	22.3	±1.0	7,368	4,927,904	15.2	±0.4
Hearing impairment	4,588	3,033,342	53.2	±1.2	18,570	12,849,642	38.9	±0.7
Heart problems	3,712	2,146,154	42.9	±1.2	14,989	10,247,372	31.0	±0.5
Hypertension	5,487	3,467,766	61.0	±1.3	26,554	17,554,971	53.3	±0.5
Joint symptoms	5,553	3,562,836	69.1	±1.2	23,933	15,935,696	55.7	±0.6
Low back pain	3,812	2,417,301	42.6	±1.2	14,934	9,908,903	30.1	±0.5
Stroke	1,321	879,368	15.5	±0.9	4,117	2,808,141	8.5	±0.6

^aWeight for population estimate – final annual sample adult weight averaged by 8.

Data Source: National Center for Health Statistics. (1997–2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from [p://www.cdc.gov/nchs/nhis.htm](http://www.cdc.gov/nchs/nhis.htm).

both vision loss and the comorbid condition of interest. Our results focus on identifying older adults with moderate/severe difficulty walking a quarter-mile, climbing stairs, shopping, and socializing, because respondents who had mild difficulty were highly similar to adults who reported no difficulty at all with these activities.

Diabetes

As shown in Table 1, about 15.2% of all people age 65 and over in the U. S. reported having diabetes; among older people reporting vision loss, 22.3% also reported having diabetes, representing 1,243,200 people age 65 or older. Findings reported in Table 2 show that the combination of visual impairment and diabetes in older adults poses a greater risk of negatively affecting functioning, participation, and health status than does having either of the conditions, but not both. Among those without diabetes or vision loss, 16.3% reported moderate or severe difficulty (hereafter referred to simply as “difficulty”) walking, and 17.7% reported difficulty climbing stairs. Among older people with vision loss *only*, 40.1% reported difficulty walking, and 32.0% reported difficulty climbing stairs. For older adults with diabetes *only*, 36.6% reported difficulty walking, and 28.6% had difficulty climbing stairs. However, for older adults who reported both vision loss *and* diabetes, walking and climbing stairs represent substantial difficulty: 52.8% reported difficulty walking, and 44.2% reported difficulty climbing stairs.

A similar pattern occurs in the two participation measures selected in this study. Among people 65 and over with neither vision loss nor diabetes, 6.2% reported difficulty shopping, and 4.8% had diffi-

culty socializing. Of older adults with vision loss *only*, 21.6% reported difficulty shopping and 17.1% had difficulty socializing. In the group of older adults with diabetes *only*, 17.2% reported difficulty shopping, and 13.3% reported difficulty socializing. However, for older adults with both vision loss *and* diabetes, 31.4% reported difficulty shopping and 25% reported difficulty socializing. In other words, people with both vision loss and diabetes had 6.8 times the odds of experiencing difficulty shopping and 6.4 times the odds of experiencing difficulty socializing, compared with older adults who had no diabetes and no vision loss.

Negative changes in health status appear to mirror these differences. While 10.3% of older people with neither vision loss nor diabetes reported health as worse in the last year, poorer health was reported by 25.0% of the group with vision loss *only*, 19.9% with diabetes *only*, and 31.7% with both vision loss and diabetes.

We examined eight additional pairs of conditions occurring with vision impairment. In the majority of cases, the pattern was the same. Vision loss in combination with other conditions substantially compromised the performance of activities and participation and was related to poorer health status.

Hypertension and heart disease

Hypertension affected well over half of our study population aged 65 and over, and nearly a third (31.0%) reported heart problems (coronary heart disease, angina, and myocardial infarction). As depicted in Table 3, hypertension in combination with vision loss affected each domain of functional activities, participation, and health status. Older people with both

Table 2
Older adults with and without diabetes and visual impairment (VI) who experience moderate-to-severe limitations and health status.

Domain	No VI, no diabetes ^a			Diabetes only			VI only			Both VI & diabetes		
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI
Difficulty walking ¼ mile	16.3	1.0	—	36.6	2.3	±0.2	40.1	2.8	±0.2	52.8	5.7	±0.6
Difficulty climbing steps	17.7	1.0	—	28.6	2.3	±0.1	32.0	2.9	±0.2	44.2	5.8	±0.7
Difficulty shopping	6.2	1.0	—	17.2	2.3	±0.1	21.6	3.4	±0.3	31.4	6.8	±0.8
Difficulty socializing	4.8	1.0	—	13.3	2.0	±0.2	17.1	3.4	±0.3	25.0	6.4	±0.9
Health status												
Better	12.6	1.0	—	16.5	1.5	±0.1	12.7	1.1	±0.1	14.4	1.6	±0.2
Worse	10.3	1.0	—	19.9	1.8	±0.1	25.0	2.6	±0.2	31.7	4.4	±0.5
Same ^a	77.1	1.0	—	63.6	1.0	—	62.2	1.0	—	53.9	1.0	—

^aReference group for multivariate analysis.

Note: CI = confidence interval. AOR = adjusted odds ratio. All AORs adjusted by age, race/ethnicity and sex. Findings statistically significant at $p < .001$.

Data Source: National Center for Health Statistics. (1997–2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from <http://www.cdc.gov/nchs/nhis.htm>.

vision loss and hypertension reported 5.1 times the odds of experiencing difficulty walking a quarter-mile, compared with those who had neither condition (45.3% vs. 13.3%) and 5.1 times the odds of experiencing difficulty climbing ten steps (36.6% vs. 9.7%) compared to those with no hypertension and no vision loss. Similarly, older people with vision loss and hypertension reported 5.4 times the odds of having difficulty shopping (24.2% vs. 5.2%) and 5.2 times the odds of having moderate/severe difficulty socializing (19.4% vs. 4.2%). Self-reported worsening health reflected similar patterns among the four groups: no vision loss/no hypertension, 9.2%; hypertension only, 15.5%; vision loss only, 25.0%; and both vision loss and hypertension, 26.7%.

As shown in Table 4, older people with a history of heart disease reported compromised activity, participation, and health status (difficulty walking, 33.9%; climbing steps, 25.8%; shopping, 15.7%; socializing, 15.7%; and worse health, 19.7%). Those with heart problems *and* vision loss had 6.6 times the odds of experiencing difficulty walking, 6.8 times climbing steps, 7.7 times shopping, and 7.4 times socializing. Almost a third (30.4%) reported worsening health.

Depression risk

Of particular concern is the frequency and effect of depression among older people, especially those with vision loss. More than two-fifths of people over age 65 (43.5%) reported risk of mild or moderate depression, and 2.5% are at risk of having severe depression. Among older people with vision impairment, 57.2% are at risk of mild or moderate depression and

6.2% are at risk of severe depression, representing 3.3 million and 350,000 people, respectively (see Table 1).

Table 5 summarizes our findings on depression risk. While older people reporting risk of mild or moderate depression indicated difficulty walking (28.9%), climbing stairs (21.2%), shopping (12.9%), and socializing (9.9%), those with similar risk of depression *and* vision loss reported substantially greater difficulty walking (43.0%), climbing stairs (33.7%), shopping (23.0%), and socializing (18.2%).

A total of 63.2% of people with severe risk of depression reported moderate or severe difficulty walking a quarter of a mile; 74.0% of those with both vision impairment and severe depression risk reported difficulty walking. Similarly, difficulty climbing stairs increased from 54.7% for those with severe depression risk to 65.2% for those with severe depression and vision loss. Difficulty shopping increased from 41.5% to 50.6%, and difficulty socializing from 37.1% to 45.1%. Moreover, while 46.4% of those with severe depression risk but no vision loss reported worse health within the last 12 months, 55.7% of those with both vision impairment and severe depression risk reported declining health.

Stroke

Almost 900,000 older people nationally reported having both vision impairment and stroke, a condition that may contribute to vision impairment. In the study sample, as shown in Table 6, almost half (49.6%) of older people who experienced a stroke reported difficulty walking, and 39.9% reported difficulty climbing stairs. More than one quarter (27.5%) reported

Table 3
Moderate/severe functional limitations and health status for older adults with comorbid hypertension and visual impairment (VI).

Domain	No VI, no hypertension ^a			Hypertension only			VI only			Both VI & hypertension		
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI
Difficulty walking ¼ mile	13.3	1.0	—	27.2	1.9	±0.1	40.1	2.9	±0.2	45.3	5.1	±0.4
Difficulty climbing 10 steps	9.7	1.0	—	20.3	1.7	±0.1	32.0	3.0	±0.2	36.6	5.1	±0.5
Difficulty shopping	5.2	1.0	—	11.6	1.6	±0.1	21.6	3.5	±0.3	24.2	5.4	±0.5
Difficulty socializing	4.2	1.0	—	8.9	1.5	±0.1	17.1	3.5	±0.3	19.4	5.2	±0.6
Health status												
Better	11.4	1.0	—	14.7	1.4	±0.08	12.7	1.1	±0.08	13.8	1.5	±0.1
Worse	9.2	1.0	—	15.5	1.5	±0.08	25.0	2.7	±0.2	26.7	1.7	±0.3
Same ^a	79.5	1.0	—	69.9	1.0	*	62.2	1.0	*	59.5	1.0	*

^aReference group for multivariate analysis.

Note: CI = confidence interval. AOR = adjusted odds ratio. All AORs adjusted by age, race/ethnicity and sex. Findings statistically significant at *p* < .001.

Data Source: National Center for Health Statistics. (1997-2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from <http://www.cdc.gov/nchs/nhis.htm>.

Table 4
Moderate/severe functional limitations and health status for older adults with comorbid heart problems and visual impairment (VI).

Domain	No VI, no heart problems ^a			Heart problems only			VI only			Both VI & heart problems		
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI
Difficulty walking ¼ mile	14.1	1.0	—	33.9	2.6	±0.1	40.1	2.7	±0.2	51.0	6.6	±0.6
Difficulty climbing 10 steps	10.1	1.0	—	25.8	2.5	±0.2	32.0	2.7	±0.2	42.1	6.8	±0.7
Difficulty shopping	5.2	1.0	—	15.7	2.5	±0.2	21.6	3.2	±0.2	28.9	7.7	±0.8
Difficulty socializing	4.1	1.0	—	15.7	2.4	±0.2	17.1	3.1	±0.3	23.3	7.4	±0.9
Health status												
Better	11.6	1.0	—	16.6	1.8	±0.1	12.7	1.1	±0.08	14.8	1.9	±0.2
Worse	8.8	1.0	—	19.7	2.1	±0.1	25.0	2.5	±0.2	30.4	5.0	±0.4
Same ^a	79.6	1.0	—	63.7	1.0	*	62.2	1.0	*	54.8		

^aReference group for multivariate analysis.

Note: CI = confidence interval. AOR = adjusted odds ratio. All AORs adjusted by age, race/ethnicity and sex. Findings statistically significant at $p < .001$.

Data Source: National Center for Health Statistics. (1997-2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from <http://www.cdc.gov/nchs/nhis.htm>.

Table 5
Moderate/severe limitations and health status for older adults with comorbid depression risk and visual impairment (VI).

Domain	Older adults with mild-moderate depression risk															
	No depression risk, no VI ^a				Mild/moderate depression risk only				VI only				Both VI & mild/moderate depression risk			
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	
Difficulty walking ¼ mile	12.4	1.0	—	28.9	2.1	±0.1	40.1	2.5	±0.2	43.0	5.1	±0.4				
Difficulty climbing 10 steps	8.9	1.0	—	21.2	2.0	±0.1	32.0	2.6	±0.2	33.7	4.9	±0.4				
Difficulty shopping	4.1	1.0	—	12.9	2.2	±0.2	21.6	2.9	±0.2	23.0	6.7	±0.3				
Difficulty socializing	3.2	1.0	—	9.9	2.1	±0.2	17.1	2.9	±0.2	18.2	6.4	±0.8				
Health status																
Better	12.6	1.0	—	14.0	1.3	±0.03	12.7	1.1	±0.08	13.9	1.5	±0.1				
Worse	6.9	1.0	—	18.0	2.4	±0.1	25.1	2.2	±0.1	26.8	5.3	±0.4				
Same ^a	80.5	1.0	—	68.0	1.0	*	62.2	1.0	*	59.3	1.0	*				
Domain	Older adults with severe depression risk															
	No depression risk, no VI ^a				Severe depression risk only				VI only				Both severe depression risk & VI			
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	
Difficulty walking ¼ mile	12.4	1.0	—	63.2	7.9	±1.2	40.1	2.5	±0.2	74.0	19.5	±4.8				
Difficulty climbing steps	8.9	1.0	—	54.7	7.7	±1.1	32.0	2.6	±0.2	65.2	18.5	±4.3				
Difficulty shopping	4.1	1.0	—	41.5	9.4	±1.5	21.6	2.9	±0.2	50.6	23.3	±5.6				
Difficulty socializing	3.2	1.0	—	37.1	10.0	±1.6	17.1	2.9	±0.2	45.1	23.9	±5.7				

(Continued)

Table 6
Moderate/severe functional limitations and health status for older adults with comorbid stroke and visual impairment (VI).

Domain	No VI, no stroke ^a			Stroke only			VI only			Both VI & stroke		
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI
Difficulty walking ¼ mile	16.4	1.0	—	49.6	3.9	±0.3	40.1	2.7	±0.2	64.6	9.5	±1.3
Difficulty climbing 10 steps	11.6	1.0	—	39.9	3.7	±0.3	32.0	2.8	±0.2	53.9	9.1	±1.3
Difficulty shopping	6.0	1.0	—	27.5	4.1	±0.4	21.6	3.2	±0.3	40.6	10.9	±1.7
Difficulty socializing	4.5	1.0	—	23.0	4.2	±0.4	17.1	3.2	±0.3	35.1	11.5	±1.8
Health status												
Better	13.0	1.0	—	15.7	1.6	±0.1	12.7	1.1	0.08	14.5	1.8	±0.3
Worse	10.2	1.0	—	27.0	2.6	±0.2	25.0	2.6	0.2	37.9	6.0	±0.7
Same ^a	76.9	1.0	—	57.3	1.0	*	62.2	1.0	*	47.6	1.0	*

^aReference group for multivariate analysis.

Note: CI = confidence interval. AOR = adjusted odds ratio. All AORs adjusted by age, race/ethnicity and sex. Findings statistically significant at $p < .001$.

Data Source: National Center for Health Statistics. (1997–2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from <http://www.cdc.gov/nchs/nhis.htm>.

difficulty shopping, 23% had difficulty socializing, and 27% described their health as worse than it was a year ago. Among older adults who reported stroke in combination with vision loss, difficulties were experienced by 64.6% in walking; 53.9% climbing stairs; 40.6% shopping, and 35.1% socializing; in this group, 37.9% reported their health as worse than a year ago.

Hearing impairment

Table 7 depicts our findings on vision impairment and comorbid hearing. Adults age 65 and older with both vision and hearing impairment were more likely to have moderate to severe difficulty walking, compared with respondents who had hearing impairment but no vision impairment (44.0% vs. 27.7%). Older adults with both conditions also experienced higher levels of difficulty climbing stairs (35.2% vs. 20.6%), shopping (24.2% vs. 12.6%), and socializing (19.2% vs. 9.6%), as well as worsened health status (28.8% vs. 17.7%).

Joint problems and low back pain

We found a similar pattern for joint symptoms and low back pain. Compared with older adults who experienced joint symptoms and no vision impairment, those with both vision impairment and joint symptoms evidenced increased rates of physical and social limitations and worsening health (see Table 8). Those with both conditions also reported a higher rate of difficulty walking (46.8% vs. 30.9%), climbing stairs (38.2% vs. 23.4%), shopping (24.8% vs. 13.1%), and socializing (19.7% vs. 10.0%); this held true with regard to decline in health status (29.3% vs. 18.0%).

Table 9 reveals a similar pattern for all functional limitations, participation, and worsening health among older adults with low back pain only and those with both vision impairment and comorbid low back pain. Rates of difficulty walking (50.3% vs. 34.1%), climbing stairs (41.3% vs. 25.8%), shopping (26.6% vs. 15.2%), socializing (21.1% vs. 11.4%), and worsening health (32.5 vs. 21.3%) were substantially higher for older adults with visual impairment and comorbid low back pain, compared with those experiencing low back pain alone.

Breathing problems

People with combined vision impairment and breathing problems showed higher rates of physical and social limitations, and poorer self-reported health status than did older adults with either condition alone (see Table 10). Compared with those who experienced breathing problems but no visual impairment, older adults with both vision loss and breathing problems reported significantly higher rates of difficulty walking (52.0% vs. 37.0%), climbing stairs (44.7% vs. 37.0%), shopping (28.5% vs. 16.8%), and socializing (23.1% vs. 12.8%), and worsening health (33.5% vs. 22.1%).

MOST LIMITING COMORBID CONDITIONS

In all cases, having both a visual impairment and a comorbid health condition was associated with the greatest limitations in physical functioning and participation, and the likelihood of experiencing worsening health during the previous 12 months. In all but two instances (depression risk and stroke), vision impairment was the second most important indicator for experiencing moderate

Table 7
Moderate/severe functional limitations and health status for older adults with comorbid hearing impairment and visual impairment (VI).

Domain	No VI, no hearing impairment ^a			Hearing impairment only			VI only			Both VI & hearing impairment		
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI
Difficulty walking ¼ mile	15.6	1.0	—	27.7	1.8	±0.09	40.1	2.7	±0.2	44.0	4.6	±0.4
Difficulty climbing 10 steps	11.4	1.0	—	20.6	1.7	±0.1	32.0	2.8	±0.2	35.2	4.7	±0.4
Difficulty shopping	5.8	1.0	—	12.6	1.8	±0.1	21.6	3.3	±0.2	24.2	5.7	±0.8
Difficulty socializing	4.6	1.0	—	9.6	1.7	±0.2	17.1	3.3	±0.3	19.2	5.4	±0.6
Health status												
Better	15.4	1.0	—	12.7	1.0	±0.06	12.7	1.2	±0.08	12.1	1.2	±0.1
Worse	9.1	1.0	—	17.7	1.7	±0.09	25.0	2.5	±0.2	28.8	4.2	±0.3
Same ^a	77.5	1.0	—	69.6	1.0	*	62.2	1.0	*	59.1	1.0	*

^aReference group for multivariate analysis.

Note: CI = confidence interval. AOR = adjusted odds ratio. All AORs adjusted by age, race/ethnicity and sex. Findings statistically significant at $p < .001$. Data Source: National Center for Health Statistics. (1997-2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from <http://www.cdc.gov/nchs/nhis.htm>.

Table 8
Moderate/severe functional limitations and health status for older adults with comorbid joint problems and visual impairment (VI).

Domain	No VI, no joint problems ^a			Joint problems only			VI only			Both VI & joint problems		
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI
Difficulty walking ¼ mile	12.1	1.0	—	30.9	2.6	±0.2	40.1	2.6	±0.2	46.8	6.1	±0.5
Difficulty climbing 10 steps	8.6	1.0	—	23.4	2.5	±0.2	32.0	2.7	±0.2	38.2	6.2	±0.6
Difficulty shopping	5.1	1.0	—	13.1	2.1	±0.2	21.6	3.2	±0.3	24.8	5.8	±0.6
Difficulty socializing	4.1	1.0	—	10.0	2.0	±0.2	17.1	3.2	±0.3	19.7	5.5	±0.6
Health status												
Better	12.5	1.0	—	13.7	1.2	±0.07	12.7	1.1	±0.09	11.6	1.4	±0.1
Worse	8.3	1.0	—	18.0	2.1	±0.1	25.0	2.5	±0.2	29.3	4.8	±0.4
Same ^a	79.2	1.0	—	68.3	1.0	*	62.2	1.0	*	58.2	1.0	*

^aReference group for multivariate analysis.

Note: CI = confidence interval. AOR = adjusted odds ratio. All AORs adjusted by age, race/ethnicity and sex. Findings statistically significant at $p < .001$.

Data Source: National Center for Health Statistics. (1997-2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from <http://www.cdc.gov/nchs/nhis.htm>.

Table 9
Moderate/severe functional limitations and health status for older adults with comorbid low back pain and visual impairment (VI).

Domain	No VI, no low back pain ^a			Low back pain only			VI only			Both VI & low back pain		
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI
Difficulty walking ¼ mile	14.2	1.0	—	34.1	2.4	±0.1	40.1	2.9	±0.2	50.3	5.9	±0.5
Difficulty climbing 10 steps	10.2	1.0	—	25.8	2.2	±0.1	32.0	2.9	±0.3	41.3	5.9	±0.3
Difficulty shopping	5.3	1.0	—	15.2	2.1	±0.2	21.6	3.8	±0.4	26.6	6.1	±0.7
Difficulty socializing	4.3	1.0	—	11.4	1.9	±0.2	17.1	3.2	±0.4	21.1	5.7	±0.7
Health status												
Better	12.8	1.0	—	13.7	1.2	±0.07	12.7	1.1	±0.08	12.4	1.4	±0.1
Worse	8.5	1.0	—	21.3	2.3	±0.1	25.0	2.5	±0.1	32.5	5.4	±0.5
Same ^a	78.6	1.0	—	65.0	1.0	*	62.2	1.0	*	55.1	1.0	*

^aReference group for multivariate analysis.

Note: CI = confidence interval. AOR = adjusted odds ratio. All AORs adjusted by age, race/ethnicity and sex. Findings statistically significant at $p < .001$.

Data Source: National Center for Health Statistics. (1997-2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from <http://www.cdc.gov/nchs/nhis.htm>.

Table 10
Moderate/severe functional limitations and health status for older adults with comorbid breathing problems and visual impairment (VI).

Domain	No VI, no breathing problems ^a			Breathing problems only			VI only			Both VI & breathing problems		
	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI	%	AOR	AOR 95%CI
Difficulty walking ¼ mile	16.1	1.0	—	37.0	2.3	±0.1	40.1	2.8	±0.3	52.0	5.8	±0.7
Difficulty climbing 10 steps	11.4	1.0	—	37.0	2.3	±0.2	32.0	2.9	±0.2	44.7	6.3	±0.8
Difficulty shopping	6.1	1.0	—	16.8	2.0	±0.2	21.6	3.4	±0.3	28.5	6.1	±0.8
Difficulty socializing	4.7	1.0	—	12.8	2.0	±0.2	17.1	3.4	±0.3	23.1	6.0	±0.9
Health status												
Better	12.8	1.0	—	15.4	1.4	±0.1	12.7	1.4	±0.08	13.8	1.6	±0.2
Worse	9.8	1.0	—	22.1	2.1	±0.1	25.0	2.1	±0.3	33.5	5.0	±0.5
Same ^a	77.4	1.0	—	62.5	1.0	*	62.2	1.0	*	52.7	1.0	*

^aReference group for multivariate analysis.

Note: CI = confidence interval. AOR = adjusted odds ratio. All AORs adjusted by age, race/ethnicity and sex. Findings statistically significant at $p < .001$.

Data Source: National Center for Health Statistics. (1997–2004). *National Health Interview Survey, Sample Adult Files*. Hyattsville, MD: Centers for Disease Control and Prevention. Retrieved January 5, 2006, from <http://www.cdc.gov/nchs/nhis.htm>.

to severe difficulty walking, climbing stairs, shopping, and socializing, and for reporting worsening health over the past year. Among older adults with visual impairment, the highest rates of difficulty walking were associated with comorbid stroke (64.6%), diabetes (52.8%), breathing problems (52.0%), and heart problems (51.0%). Comorbidities with visual impairment that were most strongly associated with difficulty climbing stairs were stroke (53.9%), breathing problems (44.7%), diabetes (44.2%), and heart problems (42.1%).

With regard to our participation measures, comorbidities most strongly associated with difficulty shopping were severe depression (50.6%), stroke (40.6%), diabetes (31.4%), and breathing problems (28.5%). Older adults with visual impairment who experienced the greatest difficulty socializing reported the following comorbidities: severe depression (45.1%), stroke (35.1%), diabetes (25.0%), and heart problems (23.3%). Among those who said that their health had declined in the previous year, the highest rates of worsening health were associated with the following comorbid conditions: severe depression (55.7%), stroke (37.9%), breathing problems (33.5%), and low back pain (32.5%).

Discussion

In the present study, we examined outcome variables for older adults with vision loss who had single comorbid conditions, but it is possible that our respondents may have had more than one coexisting comorbid condition. We recognize that our findings for interactions between vision impairment and single chronic comorbid conditions may be confounded in cases in which respondents had additional coexisting chronic conditions. Further research

is needed to investigate the effects of multiple comorbid conditions on older adults with vision loss.

This is the fourth in a series of articles exploring the multiple effects of vision loss on older people. The first of these (Crews & Campbell, 2001) employed data from the 1994 Second Supplement on Aging, which was a module addressing aging issues in the 1994 National Health Interview Survey (NHIS), to compare older people with and without vision loss on a variety of conditions and measures of activity and participation. The substantial differences found led us to consider the effects of sensory loss more generally among older people; therefore, the second paper (Crews & Campbell, 2004) explored the effects of vision loss, hearing loss, and both vision and hearing loss on people age 70 and over. We found that the combination of vision and hearing loss substantially compromised activities and participation. This led us to think more generally about the effects of commonly occurring conditions among people as they age, and the investigation was influenced by the work of Verbrugge, Lepkowski, and Imanaka (1989). A preliminary analysis (Crews, Valluru, & Campbell, 2005) and now this study further explore those concerns.

Although vision loss does not occur in isolation, but in the context of other age-related problems, our findings here were largely unexpected. We did not anticipate that the estimated populations of people experiencing vision loss and selected comorbid conditions would be so large. Of the 5.7 million people who are estimated to have vision loss, 3.2 million report risk of mild-to-moderate depression, 350,000 report risk of severe depression, 1.2 million

have vision loss and diabetes, and 3 million report both vision and hearing loss. These are large numbers of people. And while we expected to find differences in activity level, social participation, and health status, we did not foresee that the differences would be as great as they were. We were particularly surprised to see the extent to which risk of depression affected the lives of people with vision impairment. Similarly, conditions such as low back pain and breathing problems greatly affected mobility. These were not issues that we typically thought about.

These findings have major implications for policy and interventions in the areas of clinical services, public health, aging and disability, and vision rehabilitation. They suggest that the complexity of the circumstances faced by older people with vision loss requires multiple avenues of assessment, evaluation, and intervention. There are ample opportunities for various systems—aging, public health, health care, mental health care, and vision rehabilitation—to coordinate their efforts to reach people with vision loss who experience these comorbid conditions. The study suggests that more needs to be done to refine assessment and measurement, treatment and management, and communication and dissemination.

This paper highlights the importance of addressing the interaction between visual impairment and comorbid conditions among older adults, since measures of functioning, participation, and worsening health were most strongly affected by having both visual impairment and a comorbid condition. Our findings suggest that health promotion interventions directed toward people with vision impairments would have substantial potential to improve the

health of a large population. There are at least three domains—health care, rehabilitation, and the environment—where changes might occur to improve the overall health of people with vision loss.

THE HEALTH CARE SYSTEM

If physicians and other health care professionals were aware of these findings, they might do more to encourage exercise and better nutrition among older people with visual impairments, and thus prevent or ameliorate the effects of hypertension, heart disease, stroke, diabetes, and respiratory problems. Our findings regarding depression suggest that health and mental health professionals need to be more aggressive in diagnosing and treating depression in this population. For people with diabetes, refining strategies to examine skin, for example, may be particularly important when one has diabetic retinopathy and diabetic neuropathy. How does a person determine the integrity of skin if he or she can neither see nor feel it?

Moreover, for people with multiple health problems, managing medicine might be particularly important. Better labeling on medicine bottles might lead to greater compliance and fewer drug interactions (Windham et al., 2005). In addition, programs targeting older people with various health promotion campaigns might more effectively reach older visually impaired people if special efforts were made to make materials accessible—in large print with better color contrast, in braille, and in aural presentations.

THE REHABILITATION SYSTEM

Improved exercise and conditioning—perhaps facilitated by orientation and mobility instructors in rehabilitation

programs for blind and visually impaired people—might have the potential to improve hypertension and heart and respiratory function. Rehabilitation counselors may be able to address nutrition, meal planning, cooking skills, and shopping techniques to improve overall nutrition and health.

THE ENVIRONMENT

Changes in the environment may also have the potential to improve health among older adults with vision loss and a comorbid condition. Beyond better medicine and product labels, as already noted, improved sidewalks, safer pedestrian crossings, and increased illumination could encourage physical exercise in the community and promote social participation.

These circumstances do not occur in isolation from each other. If people have difficulty shopping for food, then meal choices might be limited and not as healthy as one would desire. Moreover, our findings with regard to depression suggest that if mental health professionals could more effectively address depression among people with vision loss, these people might be more successful in rehabilitation programs. Conversely, if people are successful in rehabilitation programs, that experience might help to improve mood. The complexity of outcomes among older people with comorbid conditions implies that solutions may occur at a systems level, where health care, rehabilitation, public health, and the environment work together to promote health and thus increase social participation.

Given the population numbers we have estimated here, modest improvements in these nine combinations of conditions can create opportunities for improvements in functioning, participation, and overall health.

Limitations

We wish neither to overstate nor understate the complexity of circumstances facing older people with vision loss. Vision loss rarely occurs as an isolated event, and combinations of comorbid conditions do not present themselves in neat packages of dyads. We recognize that this approach simplifies human experience. Moreover, we selected outcomes indicators as representative dimensions of the ICF. Additional outcomes measures should be examined. We limited our analysis in order to explore multiple conditions. Finally, the condition list as we have constructed it from the NHIS could be refashioned to be more reflective of the ICF framework.

Conclusions

The results of this study underscore the importance of greater attention to addressing the multiple needs of older people who are visually impaired. Activities once effortless and routine may become severely compromised; social roles central to one's identity may be abandoned. We suggest that systems be reexamined so as to establish and integrate public health approaches into programs and interventions for older people with vision impairments, and thus to benefit general health, daily functioning, and social participation.

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