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Presence of Vision Impairment and Risk of Hospitalization Among Elderly Medicare Beneficiaries

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Abstract

PURPOSE—To examine the association between vision impairment and all-cause hospitalization among elderly Medicare beneficiaries.

METHODS—A population-based study (n= 22,681) of community-dwelling Medicare beneficiaries aged 65 years and older who participated in the Medicare Current Beneficiary Survey for years 2001–2007. Beneficiaries were classified into self-reported presence of vision impairment versus no vision impairment. Inpatient hospitalizations were identified using Medicare claims data. A multivariable Cox proportional hazard model examined the association between presence of vision impairment and time to first hospitalization within three years of survey entry after adjusting for sociodemographics, comorbidities, hearing impairment, and activity limitation stages derived from difficulty performing the activities of daily living.

RESULTS—Medicare beneficiaries who self-reported the presence of vision impairment were significantly more likely to be hospitalized over three years compared to beneficiaries without vision impairment even after adjustment for potentially influential covariates (hazard ratio = 1.14 and 95% confidence interval: 1.05–1.23).

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CONCLUSIONS—Medicare beneficiaries with self-reported vision impairment were at higher risk of hospitalization during a three-year period. Further research may identify reasons that are amenable to policy interventions.

Keywords

Disability; Medicare; Access to care; visual disorders; elderly; hospitalization

INTRODUCTION

Vision impairment is common among older adults and the prevalence increases with advancing age.¹ Vision loss in older adults influences function and the ability to live independently.² Vision impairment also negatively influences quality of life, leads to social isolation and depression, and is associated with increased mortality.³ While isolation and participation restriction carry a great cost and caregiver burden, vision impairment may also affect health care access and utilization. Spencer et al. found that individuals with blindness and vision impairment had increased difficulty with healthcare access due to issues such as cost of care and refusal of services by providers.⁴ Therefore, older adults with vision impairment may have unmet healthcare needs, use fewer preventive services, and be dissatisfied with services.^{5–9}

Previous international studies have suggested an association between vision impairment and hospitalization.¹⁰ Among a sample of younger and older legally blind individuals and normally sighted controls in Western Australia, the blind cohorts had increased rates of hospitalization in both the younger and older samples.¹⁰ Among the elderly blind cohort there were more admissions for diabetes with complications, pulmonary disease, and anemia compared with the controls.¹⁰ In addition, an international review of costs and intangible effects of vision impairment and blindness found that hospitalization was one of the largest contributors to direct medical costs in those with vision impairment.¹¹

Vision impairment may be associated with chronic disease. The Sick Eye, Sick Body hypothesis elucidates a link between ocular conditions and systemic illnesses such as coronary vascular disease, which is associated with primary open angle glaucoma, diabetic retinopathy, and age-related macular degeneration.¹² The likely causal link between such medical comorbidities and vision impairment is an important consideration. To our knowledge, no studies to date in the United States have examined whether persons with vision impairment are at increased risk for hospitalization or the diagnoses associated with hospitalization for beneficiaries with and without vision impairment.

Our goal was to assess whether blindness and vision impairment were independently associated with time to first hospitalization among elderly Medicare beneficiaries. We hypothesized that elderly Medicare beneficiaries who reported blindness or vision impairment would have a greater risk of any hospitalization over a three-year period compared to beneficiaries without vision impairment, even after controlling for sociodemographics, medical comorbidities, hearing impairment, and activity limitation stages. In addition, we sought to explore in a preliminary fashion the top diagnoses associated with hospitalization in beneficiaries with and without vision impairment.

MATERIALS AND METHODS

Study Design and Sample

In this cohort study, we examined 22,957 community-dwelling Medicare beneficiaries aged 65 years and older who participated in the Medicare Current Beneficiary Survey (MCBS) during the calendar years 2001–2007.^{13–15} We followed the entry cohorts for three years, except for loss to follow-up or death. Beneficiaries were also excluded if they did not provide complete information for our study analysis. In all, we excluded 170 beneficiaries with incomplete information on activities of daily living (ADLs), 13 beneficiaries with missing data on race, 32 beneficiaries who were admitted to the hospital prior to the observation period, and 121 beneficiaries who were enrolled in a capitated program. Our final study sample included 22,681 Medicare beneficiaries.^{14–16}

The MCBS is a nationally representative sample of the Medicare population, which oversamples beneficiaries aged 80 and older.¹⁶ The MCBS data were collected by the Centers for Medicare and Medicaid Services through in-person beneficiary or proxy interviews. Sample persons are interviewed three times a year over four years. The MCBS data contains individual-level information on sociodemographics, health and functioning status, and medical encounters. Interviews were conducted in person or in homes. If a beneficiary was unable to provide a response in English or Spanish, a family member served as a proxy to interpret. The MCBS releases annual Cost and Use files that link Medicare claims to the survey. Medicare claims are available for three consecutive years starting on January 1st of the year following the initial survey. This study was approved by the Institutional Review Board at the University of Pennsylvania and adhered to the tenets of the Declaration of Helsinki.

Outcome and Censoring

The outcome of interest was time to first hospitalization in the three year follow-up period. Inpatient hospitalizations were identified using Medicare claims data. Death and loss to follow-up were considered censoring events. Reason for hospitalization in beneficiaries with and without vision impairment was examined using Major Diagnostic Categories (MDC). These categories are formed by dividing all possible Medicare Diagnosis Related Group (MS-DRG) diagnoses into 27 diagnostic areas corresponding to a single organ system or etiology.¹⁷

Vision Impairment

Beneficiaries were asked two questions, “Do you wear eyeglasses or contact lenses?” and “Which statement best describes your vision while wearing glasses or contact lenses?” Responses included yes, no, or blind for the first question and no trouble seeing, a little trouble seeing, or a lot of trouble seeing for the second question. Beneficiaries were classified into self-reported presence of vision impairment if they reported that they were blind in question one or indicated that they had a lot of trouble in question two. All other responses were considered no vision impairment. Vision impairment was ascertained only at baseline during entry into the survey. We used self-reports of vision impairment for the

assessment of general vision that were similar to those used by other investigators, most specifically Klein et al.¹⁸

Sociodemographic and Clinical Characteristics

Sociodemographics, covariates and baseline vision impairment were identified at entry into the MCBS and were used to examine the association with time to first hospitalization during the subsequent three years. Sociodemographics included sex, age (in years), race or ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or other)¹⁹ dual enrollment in Medicare and Medicaid, and living arrangement (alone versus other). Comorbidities were determined by the beneficiaries' report of doctors' diagnoses. We chose to include the self-reported comorbidities based on what was available in the MCBS. The available data on comorbidities and clinical characteristics included hypertension, myocardial infarction, angina/chronic heart disease, other heart disease, stroke, diabetes mellitus, Parkinson's disease, emphysema/asthma/chronic obstructive pulmonary disease, rheumatoid arthritis, non-rheumatoid arthritis, osteoporosis/soft bones, cancers other than skin, mental retardation, Alzheimer's/dementia, complete/partial paralysis, and mental/psychiatric disorder, as well as presence of a hearing impairment.

Answers to simple questions about difficulties performing basic activities were used to derive standardized activity limitation stages at baseline. For each ADL activity, respondents are asked, "Because of a health condition, do you have difficulty with [activity]?"^{20,21} The ADL domain activities include self-care tasks: eating, toileting, dressing, bathing/showering, getting in or out of bed/chairs, and walking. At stage 0, persons are able to carry out all 6 activities without any difficulty. At stages I and II people have progressively fewer activities that they can carry out without difficulty, starting with the harder and ending with the easiest tasks. At stage IV, persons have difficulty carrying out all 6 ADLs. The pattern of activity limitation is not hierarchical. Stage III represents people with uncommon patterns of limitations in which activities that are typically easy may be difficult or vice versa and accommodates for atypical patterns. Detailed methods have been described elsewhere.²²

Statistical Analysis

Baseline sample characteristics by presence of vision impairment were compared using χ^2 tests or t-tests as appropriate for categorical data or differences in means. A multivariable Cox proportional hazard model examined the association between presence of vision impairment and time to first hospitalization within three years of survey entry after adjusting for sociodemographics, comorbidities, hearing impairment, and function. Results were expressed as hazard ratios (HRs) and 95% confidence intervals (CIs). P-values were two-sided, with statistical significance at $p < 0.05$ in the final models. The proportional hazards assumption for the Cox regression model was tested to determine if the HRs remained constant over time in the final model. To test this assumption, the interaction between each covariate in the final model and time to first hospitalization or the end of study (three-year follow-up) was added to the final model. We added all interactions with p-values < 0.05 in the previous step to obtain the final models with main effects and interactions. In addition, we examined the top diagnoses for hospitalization in beneficiaries with and without vision

impairment. All models accounted for the complex survey design of MCBS. The analysis was conducted in SAS 9.4 (SAS Institute, Cary, NC).

RESULTS

Sample characteristics

Our sample consisted of 22,681 beneficiaries living in the community, representing 43.6 million annual beneficiaries nationwide. The distribution was 56.4% female and 81.7% non-Hispanic white. In terms of the age of the sample, the mean age was 74 years with standard error 0.05 years. Table 1 contains the complete descriptive statistics for the sample.

Vision Impairment and Time to First Hospitalization

Vision impairment by time to first hospitalization is shown in Table 2, which presents the model from a multivariable survey Cox proportional hazard model after adjusting for sociodemographics, comorbidities, hearing impairment, and function. Medicare beneficiaries who self-reported the presence of vision impairment were significantly more likely to be hospitalized over three years compared to beneficiaries without vision impairment even after adjustment for potentially influential covariates (hazard ratio (HR) = 1.14 and 95% confidence interval (CI:) (1.05–1.23)). The proportional hazards assumption with time interaction test showed that it was not significant.

Other Factors Associated with Time to First Hospitalization

As shown in Table 2, ADL stage, age, gender, ethnicity, insurance coverage, and smoking status were significantly associated with time to first hospitalization. In addition, the following medical comorbidities were significantly associated with time to first hospitalization: hypertension, myocardial infarction, angina/chronic heart disease, other heart disease, stroke, diabetes mellitus, mental retardation, Alzheimer's/dementia, Parkinson's disease, emphysema/asthma/chronic obstructive pulmonary disease, rheumatoid arthritis, cancers other than skin, and non-rheumatoid arthritis.

Top Diagnoses Associated with Hospitalization

The top ten diagnostic categories for hospitalization for beneficiaries with and without vision impairment are included in Table 3. The top diagnoses for hospitalization for beneficiaries with vision impairment included disorders of the circulatory system (22.5%), nervous system (20.5%), and respiratory system (13.5%). The top diagnoses for hospitalization for beneficiaries without vision impairment included disorders of the musculoskeletal system and connective tissue (21.9%), circulatory system (19.9%), and nervous system (15.8%). Among hospitalized beneficiaries with vision impairment compared to hospitalized beneficiaries without vision impairment, a nervous system or hepatobiliary system and pancreas diagnosis was significantly more common, while a musculoskeletal diagnosis was significantly less common (all p-values <0.05).

DISCUSSION

In this nationally representative, longitudinal survey of older Americans we found an association between vision impairment and hospitalization within three years, accounting for sociodemographics, comorbidities, hearing impairment, smoking, and function. This finding supports our original hypothesis. Our findings highlight the need for further examination of how persons with vision impairment receive and evaluate care and what may be contributing to an increased risk of hospitalization.

Vision impairment was common among older Medicare beneficiaries and the prevalence was similar to other large population studies.¹ Vision impairment is often a result of underlying medical comorbidities. Evans et al. found that while vision impairment is associated with hospitalization, part of this association is attributed to a higher number of medical comorbidities.²³ Similar to Evans et al. our results were attenuated after adjustment for medical comorbidities. However, unlike Evans et al. our results remained statistically significant after adjustment for medical comorbidities possibly due to our larger sample size. Our results suggest that the functional loss due to vision impairment and an increased need for family and community support may place older beneficiaries with vision impairment at increased risk of hospitalization.

Overall, our findings support previous international studies examining vision impairment and hospitalization.^{3,10} Only one international study did not find a significant association between severe vision impairment and hospitalization; however, despite the use of performance based measures of vision impairment, the cohort from that study was much younger and included working age adults who were 44–45 years old.²⁴ Only 29 persons in their sample were severely visually impaired or blind.²⁴ In fact, the authors comment that there is the possibility that their negative results may be due to low power.²⁴ To our knowledge, our study is the first US study to examine vision impairment and risk of hospitalization. However, one US study used New York State insurance data to examine the contribution of vision impairment to inpatient length of stay. The authors found that the mean hospital length of stay was 13.4 days for inpatients with vision impairment, 11.9 days for inpatients with either eye pathology or vision impairment, and 8.2 days for patients with no vision impairment.²⁵

We provided exploratory information about the top diagnoses for hospitalization for beneficiaries with and without vision impairment. The top ten diagnoses for hospitalization for beneficiaries with and without vision impairment were similar but differed in ways that probably reflect the case-mix of the Medicare population aged 65 years and older with and without vision impairment. Thus, the association of vision impairment and hospitalization appears to occur through pathways that cut across several medical conditions. The mechanisms underlining the link between vision impairment and time to first hospitalization may be biological, psychological, as well as social. For example, other investigators such as Pache et al. have identified ocular diagnoses associated with specific medical conditions, which may lead to an increased risk of hospitalization through biological mechanisms.¹² In addition, a higher than expected level of disability from vision impairment may lead to diminished life satisfaction and poor self-care, thus increasing the risk of hospitalization.

Finally, the requirement of increasing needs of overall care among beneficiaries with vision impairment may stress the social support network and lead to an increased risk of hospitalization as well.

Several study limitations are important for consideration. First, we only have a limited measure of vision impairment. We used a self-report measure similar to the assessment of general vision used by Klein et al., however we did not have performance-based measures.¹⁸ Such reports have varying reliability due to recall, social desirability, and other biases. Second, the MCBS data were obtained through self-or proxy responses. The proxy-related answers to questions may differ from answers provided by the sampled beneficiaries; however, we included proxy responses because substantial bias can be introduced when proxy responses are excluded,²⁶ and vision impairment is a fairly objective observation. Third, there is the potential for unmeasured factors that differ between those with and without sensory impairment. Fourth, our findings may not be generalizable to younger Medicare beneficiaries or other younger populations. Finally, we acknowledge a link between specific ocular conditions and systemic illnesses such as coronary vascular disease. Unfortunately, we do not have specific ocular diagnoses and were unable to make any conclusions about cause of vision impairment.

Vision impairment is a multidimensional condition with a significant disease burden. Our study found an association between self-reported vision impairment and hospitalization within three years in elderly Medicare beneficiaries. The increasing health care demands of individuals with vision impairment and the increasingly aging population will require changes in both policy and clinical practice. Due to the dynamic nature of vision impairment, future investigations are needed to identify the factors contributing to these hospitalizations and specific barriers to healthcare access in this population.

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Table 1

Baseline Sensory Impairment and Beneficiary Characteristics of Persons 65 years and Older in the 2001–2007 Medicare Current Beneficiary Survey Sample Stratified by Hospital Admission or No Hospital Admission Within Three Years.

	Total (Weighted %) N=22681	Hospital Admission N (row weighted %) 8350 (33.5)	No Hospital Admission N (row weighted %) 14331 (66.5)	P value
Sensory Impairment				
<u>Vision</u>				<.0001
No	20940 (93.4)	7489 (32.5)	13451 (67.5)	
Yes	1741 (6.6)	861 (47.9)	880 (52.1)	
<u>Hearing</u>				<.0001
No	20982 (93.5)	7564 (32.8)	13418 (67.2)	
Yes	1699 (6.5)	786 (43.7)	913 (56.3)	
Activity of Daily Living (ADL) Stage				
0	15704 (72.6)	4832 (27.9)	10872 (72.1)	
I	3620 (14.8)	1684 (44.6)	1936 (55.4)	
II	1843 (7.0)	1019 (53.3)	824 (46.7)	
III	1271 (4.8)	678 (51.5)	593 (48.5)	
IV	243 (0.9)	137 (56.5)	106 (43.5)	
Age (years) mean (standard error)				
	74.0 (0.05)	75.9 (0.08)	73.1 (0.02)	<.0001
Gender				
Male	9812 (43.6)	3628 (33.8)	6184 (66.2)	0.46
Female	12869 (56.4)	4722 (33.3)	8147 (66.7)	
Race/Ethnicity				
Non-Hispanic White	18615 (81.7)	7034 (34.5)	11581 (65.5)	<.0001
Non-Hispanic Black	1762 (7.8)	655 (33.9)	1107 (66.1)	
Hispanic	1636 (7.2)	445 (24.9)	1191 (75.1)	
Other	668 (3.2)	216 (27.8)	452 (72.2)	
Dual Insurance				
Medicare only	19924 (88.7)	7101 (32.4)	12823 (67.6)	<.0001
Medicare plus Medicaid	2757 (11.3)	1249 (42.5)	1508 (57.5)	
Living Arrangement				
Live with others	16387 (73.9)	5883 (32.7)	10504 (67.3)	<.0001
Live alone	6294 (26.1)	2467 (36.1)	3827 (63.9)	

	Total (Weighted %) N=22681	Hospital Admission N (row weighted %) 8350 (33.5)	No Hospital Admission N (row weighted %) 14331 (66.5)	P value
Smoking				<.0001
Non-smoker	10142 (43.8)	3521 (31.1)	6621 (68.9)	
Ever-smoked	10128 (44.4)	3919 (35.7)	6209 (64.3)	
Current-smoker	2400 (11.8)	905 (34.4)	1495 (65.6)	
Presence of Self-reported Medical Comorbidities				
Hypertension	13340 (57.7)	5306 (36.9)	8034 (63.1)	<.0001
Myocardial infarction	3114 (12.6)	1537 (47.3)	1577 (52.7)	<.0001
Angina/chronic heart disease	2277 (9.5)	1148 (48.2)	1129 (51.8)	<.0001
Other heart disease	3199 (13.0)	1540 (45.2)	1659 (54.8)	<.0001
Stroke	2504 (9.9)	1238 (47.2)	1266 (52.8)	<.0001
Diabetes mellitus	4783 (21.1)	2101 (41.0)	2682 (59.0)	<.0001
Mental retardation	61 (0.3)	33 (51.1)	28 (48.9)	0.003
Alzheimer's/dementia	646 (2.3)	340 (50.9)	306 (49.1)	<.0001
Mental/psychiatric disorder	1410 (6.2)	618 (40.6)	792 (59.4)	<.0001
Parkinson's disease	283 (1.1)	156 (52.9)	127 (47.1)	<.0001
Emphysema/asthma/Chronic Obstructive Pulmonary Disease	3024 (13.1)	1441 (45.1)	1583 (54.9)	<.0001
Complete/partial paralysis	631 (2.6)	303 (46.3)	328 (53.7)	<.0001
Rheumatoid arthritis	1921 (8.1)	858 (41.9)	1063 (58.1)	<.0001
Non-skin cancer	3924 (16.5)	1613 (38.5)	2311 (61.5)	<.0001
Non-rheumatoid arthritis	10769 (46.2)	4366 (37.7)	6403 (62.3)	<.0001
Osteoporosis/soft bones	3667 (15.4)	1449 (36.5)	2218 (63.5)	0.0001

Table 2

Association Between Baseline Sensory Impairment and Characteristics and Hospitalization Within Three Years Among Beneficiaries 65 years and Older in the 2001–2007 Medicare Current Beneficiary Survey Sample.

	Hazard Ratio (95% Confidence Interval)
Sensory Impairment	
Vision (reference: no)	1.14(1.05–1.23)
Hearing (reference: no)	0.95(0.88–1.03)
Activity of Daily Living (ADL) stage (reference: 0)	
I	1.38(1.30–1.47)
II	1.61(1.48–1.74)
III	1.63(1.48–1.79)
IV	2.23(1.82–2.72)
Age (years)	
	1.04(1.04–1.04)
Gender (reference: Female)	
Male	1.10(1.04–1.16)
Race/Ethnicity (reference: Non-Hispanic White)	
Non-Hispanic Black	0.90(0.82–0.98)
Hispanic	0.64(0.57–0.71)
Other	0.79(0.68–0.92)
Dual Insurance (reference: Medicare plus Medicaid)	
Medicare only	1.24(1.16–1.33)
Living Arrangement (reference: live with others)	
Live alone	1.03(0.98–1.09)
Smoking (reference: Non-smoker)	
Current Smoker	1.27(1.17–1.38)
Ever Smoked	1.14(1.09–1.21)
Self-reported Medical Comorbidities (reference: no)	
Hypertension	1.12(1.06–1.17)
Myocardial infarction	1.19(1.11–1.27)
Angina/chronic heart disease	1.24(1.17–1.32)
Other heart disease	1.23(1.14–1.32)
Stroke	1.15(1.07–1.23)

	Hazard Ratio (95% Confidence Interval)
Diabetes mellitus	1.22(1.16–1.29)
Mental retardation	1.50(1.03–2.20)
Alzheimer's/dementia	1.21(1.07–1.37)
Mental/psychiatric disorder	1.05(0.96–1.15)
Parkinson's disease	1.39(1.16–1.66)
Emphysema/asthma/Chronic Obstructive Pulmonary Disease	1.33(1.25–1.41)
Complete/partial paralysis	1.05(0.92–1.19)
Rheumatoid arthritis	1.13(1.05–1.22)
Non-skin cancer	1.11(1.05–1.18)
Non-rheumatoid arthritis	1.11(1.05–1.16)
Osteoporosis/soft bones	0.97(0.91–1.03)

Table 3

Top Ten Diagnostic Categories Among Beneficiaries 65 years and Older in the 2001–2007 Medicare Current Beneficiary Survey Sample Stratified by Vision Impairment and No Vision Impairment.

	Total N (%)	Vision Impairment N (Column%)	No Vision Impairment N (Column%)	P value
Musculoskeletal System & Connective Tissue	1428 (21.0)	89 (12.8)	1339 (21.9)	<.0001
Circulatory System	1369 (20.1)	156 (22.5)	1213 (19.9)	0.103
Nervous system	1108 (16.3)	142 (20.5)	966 (15.8)	0.002
Respiratory System	913 (13.4)	94 (13.5)	819 (13.4)	0.922
Ear, Nose, Mouth & Throat	653 (9.6)	67 (9.7)	586 (9.6)	0.960
Digestive System	490 (7.2)	41 (5.9)	449 (7.4)	0.163
Hepatobiliary System & Pancreas	290 (4.3)	42 (6.1)	248 (4.1)	0.014
Eye	263 (3.9)	34 (4.9)	229 (3.8)	0.137
Kidney & Urinary Tract	168 (2.5)	17 (2.5)	151 (2.5)	0.971
Infectious & Parasitic Disease & Disorders	119 (1.8)	12 (1.7)	107 (1.8)	0.965