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Poor Vision and Self-Reported Functional Difficulties among Recently Hospitalized Individuals in the United States:

Poor Vision and its Impact on Visual Function

Jeffrey Willis, MD, PhD¹ and Pradeep Ramulu, MD, PhD²

¹ Department of Ophthalmology, UC Davis Medical Center, Sacramento, CA

² Wilmer Eye Institute, The Johns Hopkins University School of Medicine, Baltimore, MD

Abstract

Purpose—Many hospitalized adults may have limited vision and as a result be at increased risk of worse functional outcomes. Here, we determine the prevalence of poor vision among recently hospitalized United States adults. Additionally, we evaluate the impact of objective vision defects on reading difficulty and external mobility outcomes (difficulty with falls and going down steps).

Methods—Our cross-sectional study included 1,347 adult Americans aged 50 years and older, all recently hospitalized, participating in the 2001-2008 National Health and Nutrition Examination Survey (NHANES). Self-reported difficulty with reading and going down steps/stairs/curbs data was collected for all participants, while data on self-reported falling difficulty was only available for the 2001-2004 NHANES (n=631). Presenting near and distance visual acuity (VA) were measured, with poor vision defined as VA worse than 20/40.

Results—Poor near and distance vision were present in 17.4% and 9.8% individuals, respectively. Multivariable analyses showed that the odds of reading difficulty were greater with worse VA (odds ratio, OR, 1.9 per 0.3 logMAR increment in near VA, 95% confidence interval, CI, 1.6-2.4, P<0.01), as were the odds of difficulty going down steps/stairs/curbs (OR 2.4 per 0.3 logMAR increment in distance VA, 95% CI 1.9-3.1, P<0.01) and odds of falling difficulty (OR 1.6 per 0.3 logMAR increment in distance VA, 95% CI 1.1-2.4, P=0.04).

Conclusion—About 1 in 10 and 1 in 6 recently hospitalized older Americans had poor distance and near vision, respectively. Many of these individuals may experience trouble reading hospital documents and ambulating, and may be at increased risk of falls.

Keywords

Epidemiology; Low vision; Visual function; Public health; Falls

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Correspondence: Pradeep Y. Ramulu, MD, PhD, pramulu@jhmi.edu.

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Introduction

Hospitalization may be particularly challenging for individuals with poor vision. First, these individuals may have difficulty reading and comprehending hospital documents such as procedural consents and discharge instructions. Furthermore, poor vision may also increase the risk of poor mobility and fall-related morbidities during and after hospitalization.¹⁻⁸ This is particularly problematic at both individual and societal levels given the large health and economic burden attributable to falls.⁹⁻¹¹ Despite these potential risks associated with poor vision, there is limited knowledge regarding the prevalence of poor vision in the hospital setting and how poor vision impacts functional outcomes (ie, reading, ambulating, and falling) in hospitalized patients.

With regard to the prevalence of poor vision among hospitalized patients, one study showed that the prevalence of visual impairment (VI) among elderly individuals admitted to a geriatrics unit was 50%.¹² Aside from this study, there is little information on the prevalence of poor vision among those that are hospitalized, and to our knowledge no nationally representative data have been reported. Additionally, relatively few studies have focused on the functional implications of poor vision among hospitalized patients, and these studies have not specifically analyzed the effects of poor near vision.^{2, 12}

Here, we assess the prevalence of poor vision in a nationally representative sample of recently hospitalized individuals using measures of both objective near and distance acuity. Second, we evaluate the impact of objectively measured vision defects on reading and external mobility outcome (ie, difficulty with going down steps/stairs/curbs and difficulty with falls) in recently hospitalized individuals in the United States. As some causes of decreased vision, uncorrected refractive error (URE) in particular, are easily correctable with minimal cost, we focus on how reading and mobility outcomes were affected by URE compared with VI (decreased vision not resulting from URE).

Materials and Methods

Study population

Data were obtained from the 2001-2008 National Health and Nutrition Examination Survey (NHANES), an ongoing cross-sectional study conducted over 2-year cycles to reflect a representative sample of the US civilian, non-institutionalized population through a multistage probability design. Survey participants underwent a comprehensive health examination, including visual acuity (VA) testing, in a mobile examination center. Home interviews were conducted to assess demographic data, self-reported visual function, self-reported difficulty with falling, and hospitalization data. Full hospitalization, VA, and visual function data were available only in individuals over 50 years, and our analyses were restricted to this group.

Ethics

The 2001-2008 NHANES was reviewed and approved by the National Center for Health Statistics Research Ethics Review Board. All participants gave written informed consent after receiving a description of the study and potential risks of participation.

Evaluation of vision

Distance presenting VA for each eye was assessed using an autorefractor containing built-in VA charts (Nidek ARK-760, Tokyo, Japan).^{5,13} Presenting distance VA was recorded as the smallest line for which 4 or more characters were read correctly. Distance VA was then re-measured with the autorefractor correction in place for all eyes with a presenting distance VA worse than 20/25. Where autorefractor results were missing from only 1 eye, and presenting distance VA in that eye was worse than 20/40, we assumed that VA in that eye did not refract to 20/40 or better. Participants with missing presenting near or distance VA in both eyes, or with VA worse than 20/40 and no autorefraction in both eyes were considered to have incomplete VA data and were excluded from all analyses.

Participants with better-eye presenting distance VA worse than 20/40 were defined as having poor distance vision. When better-eye distance presenting VA was worse than 20/40, but improved to 20/40 or better after autorefraction, individuals were further characterized as having URE. Subjects whose better-eye distance VA remained worse than 20/40 after autorefraction were further characterized as having VI.

Near VA was measured binocularly with patients wearing their own near vision corrective lenses (if any). Near VA was expressed as a Snellen equivalent and participants with presenting near VA worse than 20/40 were defined as having poor near vision. Post-refraction near VA was not determined.

Evaluation of hospitalization

Hospitalization data were obtained by asking participants “During the past 12 months, were you a patient in a hospital overnight? Do not include an overnight stay in the emergency room”. If the participant answered “don’t know,” they were categorized as not being hospitalized (n=10/10,361).

Self-reported reading difficulty

Vision-related reading difficulty was evaluated by asking patients “How much difficulty do you have reading ordinary print in newspapers?”. Patients were categorized as having reading difficulty if they reported moderate or extreme difficulty or if they noted that they were unable to read because of their vision. Patients stating they didn’t read for other reasons or who answered “don’t know” were categorized as not having reading difficulty (n=4/1,347).

Self-reported difficulty walking down steps/stairs/curbs

Mobility difficulty was evaluated by asking participants “How much difficulty do you have going down steps, stairs, or curbs in dim light or at night?”. Patients were categorized as having mobility difficulty if they reported moderate or extreme difficulty or if they noted that they were unable to do these activities because of their vision. Patients that reported that they don’t go down steps/stairs/curbs for other reasons, or who answered “don’t know” were categorized as not having mobility difficulty (n=62/1,347).

Self-reported difficulty with falling

Participants were asked about difficulty with falling during the last year. Specifically, participants were asked “During the past 12 months, have you had difficulty with falling?”. The questionnaire contained no questions on actual falls or their frequency. If the participant answered “don't know,” they were categorized as not having difficulty with falling (n=1/631).

Statistical analyses

Group differences were evaluated using χ^2 analyses and univariate regression analyses. Logistic regression analyses were used to evaluate the association between objectively measured vision and functional outcomes. In order to control for potential confounders, variables that have been previously associated with reading difficulty and mobility/falling were included in the multivariate regression models along with a variety of visual metrics for sensitivity analysis.^{14, 15} Analyses used either the 4-year (self-reported falling data was only available during the 2001-2002/2003-2004 NHANES cycles) or 8-year exam weights to adjust for the complex survey design. Data were analyzed using Stata 11 (StataCorp, College Station, TX, USA).¹⁶

Results

During the 2001-2008 NHANES, a total of 1,729 participants aged 50 years and older (17%) reported a hospitalization over the past year, and 1,347 (78%) of these participants had complete vision data. During the 2001-2004 NHANES, when self-reported falling difficulty data were available, there were a total of 843 participants aged 50 years and older (17% of the total sample) that reported a hospitalization over the past year, and among these individuals, 631 (75%) had complete vision data. Hospitalized participants with incomplete data, when compared to those with complete data, were older, more frequently obese, and more likely to have had a history of stroke (Table 1).

Objectively measured poor vision among hospitalized patients

Within this group of hospitalized participants, 17.4% (95% confidence interval, CI, 14.7-20.3%) and 9.8% (95% CI 8.2-11.7%) had poor near and distance vision, respectively. Among those with poor near vision, 63% had a Snellen equivalent of 20/63, while 37% had a Snellen equivalent worse than 20/63 (Figure 1). Among hospitalized individuals with poor distance vision, 78% had VA 20/50 or 20/60, while 22% had VA worse than 20/60 (Figure 1). The prevalence of poor distance vision secondary to URE and VI in this recently hospitalized group was 7.6% (95% CI 6.2-9.3%) and 2.2% (95% CI 1.5-3.0%), respectively (Figure 1). In comparison, among all individuals aged 50 years and older, we found that poor distance vision secondary to URE and VI was 6.3% (95% CI 5.8-7.0%, P=0.11) and 1.7% (95% CI 1.4-2.0%, P=0.89), respectively.

Vision and difficulty with reading among hospitalized patients

Difficulty with reading was reported by 31.1% and 10.0% of individuals with poor and normal near vision, respectively (P<0.01). The prevalence of difficulty with reading across those with normal distance vision, VI, and URE, was 11.7%, 49.8%, and 20.6%,

respectively ($P<0.01$; Figure 2). Multivariable models showed that self-reported reading difficulty had 1.9-fold (95% CI 1.6-2.4, $P<0.01$) and 2.6-fold (95% CI 1.9-3.5, $P<0.01$) greater odds per 0.3 logMAR increment (reflecting worse vision) in near and distance presenting VA, respectively (Table 2).

Multivariable models also showed that those with VI were significantly more likely to note difficulty with reading compared to those with normal distance vision (odds ratio, OR, 7.7, 95% CI 3.5-16.9, $P<0.01$). Those with URE also tended to report more difficulty with reading than those with normal distance vision, though results were not statistically significant (OR 1.7, 95% CI 0.9-3.2, $P=0.09$; Table 3). Further, the odds of difficulty with reading were significantly greater among those with VI than those with URE (OR 6.6, 95% CI 2.4-17.8, $P<0.01$).

Vision and difficulty walking down steps/stairs/curbs among hospitalized patients

Difficulty with walking down steps/stairs/curbs was reported by 31.4% and 9.2% of those with poor near vision and normal near vision, respectively ($P<0.01$). Among those with normal distance vision, URE, and VI, 11.4%, 15.0%, and 51.1%, respectively reported difficulties with walking down steps/stairs/curbs ($P<0.01$; Figure 2). After controlling for potential confounders, the odds of difficulty going down steps/stairs/curbs was noted to be 1.9-fold (95% CI 1.5-2.4, $P<0.01$) and 2.4-fold greater (95% CI 1.9-3.1, $P<0.01$) per 0.3 logMAR increment in near and distance presenting VA, respectively (Table 2).

Multivariable models further showed that those with VI were significantly more likely to note difficulty with going down steps/stairs/curbs compared to those with normal distance vision (OR 9.6, 95% CI 5.4-17.2, $P<0.01$). However, there was no significant difference between those with URE and normal distance vision with regards to going down steps/stairs/curbs (OR 1.3, 95% CI 0.6-3.0, $P=0.48$; Table 3). The odds of difficulty going down steps/stairs/curbs was also significantly greater among those with VI compared to those with URE (OR 9.3, 95% CI 1.5-2.4, $P<0.01$).

Vision and difficulty with falling among hospitalized Patients

Difficulty with falling was reported by 30.2% and 14.5% of those with poor near vision and normal near vision, respectively ($P=0.01$). Difficulty with falling was reported by 16.2%, 33.3%, and 19.6% among those with poor distance vision, URE, and VI, respectively ($P=0.03$; Figure 2). In multivariable models, the odds of self-reported difficulty with falling was greater with worse distance presenting VA (OR 1.6 per 0.3 logMAR increment, 95% CI 1.0-2.5, $P=0.04$). Near presenting VA was associated with mildly higher odds of falling difficulty in multivariable models, though not statistically significant (OR 1.3, 95% CI 0.9-1.8, $P=0.15$; Table 2).

In multivariable models, the odds of self-reported difficulty with falling among those with URE was 2.3-fold significantly greater (OR 2.3, 95% CI 1.0-5.3, $P=0.045$) than those with normal distance vision. There was no significant difference in self-reported difficulty with falling between those with VI and normal distance vision (OR 1.2, 95% CI 0.4-3.5, $P=0.80$; Table 3) or between those with VI and URE (OR 0.27, 95% CI 0.05-1.4, $P=0.11$).

Discussion

Roughly 1 in 6 and 1 in 10 recently hospitalized older Americans demonstrated poor near and distance VA, respectively, suggesting that many of these individuals may have experienced specific functional challenges during and after their hospitalization. Indeed, individuals with poor presenting vision were significantly more likely to report difficulties with reading and external mobility outcomes (ie, difficulty with falls and going down steps), potentially placing them at a health disadvantage compared to their better-seeing peers.^{17,18,19} Moreover, while both types of poor vision (URE and VI) were associated with functional difficulties, the type of functional difficulty experienced may be different between the 2 groups.

It is not surprising that worse vision was associated with greater difficulty with reading given that several studies have documented limited reading ability across a variety of eye diseases.^{20, 21,22} Our study found that the type of poor vision may matter in reading difficulty, as participants with VI, but not those with URE, demonstrated significantly greater reading difficulty than those with normal vision. From a practical standpoint, these results suggest that individuals with VI may have problems reading/comprehending consent forms, discharge instructions, and/or medicine bottles. Therefore, hospital personnel may want to routinely ask patients about the presence of vision problems, the type of vision difficulty, and whether they use spectacles for reading. Subsequently, if there is a problem, hospitals could present discharge instructions in large print or audio format and/or refer patients to maximize visual ability. In particular, large print documents may be cost-effective given that the majority of those with poor vision did not have severely depressed vision.

Our results also reaffirmed the importance of vision with regards to mobility/falls, an association previously described in several studies.^{1-7, 13} Our study extends these findings to a study representative of the US population that was recently hospitalized, and underscores that the type of poor vision may be relevant to difficulties in falling and ambulating in hospitalized patients, a particularly high-risk group for falls and fall-related morbidity. Specifically, we found that those with VI compared to those with URE significantly reported greater difficulty going down steps/stairs/curbs, possibly contributing to lower levels of physical activity among those with VI compared to those with URE.¹³ Such discrepancies in physical activity may explain why those with URE actually described more fall-related problems than those with VI, though this difference was not statistically significant.

The associations identified in the current study highlight the potential value of properly identifying those with poor vision and its etiology (VI vs URE) at the time of hospital admission and integrating this information into in-hospital and post-discharge mobility and fall-prevention strategies. Such strategies could potentially alleviate fall-related problems in hospitalized patients. Future research could possibly use innovative technology, such as accelerometers^{23, 24}, to evaluate the impact of poor vision and the etiology of poor vision (ie, refractive vs non-refractive) on mobility and falls to confirm our study findings.

Study limitations include our inability to categorize the etiology of the VI, and a lack of data on other visual metrics such as visual fields, depth perception, and contrast sensitivity.

Moreover, our VA data were taken from a post-hospitalization time point, and may not fully reflect vision during the actual hospitalization. Our results may also be underestimated given that our data do not reflect the vision of sicker patients that are chronically hospitalized or those that died in the hospital. Furthermore, our measure of falling did not directly assess actual fall events, and was based on the participant's interpretation of "difficulty with falling." This could have represented actual falls, fear of falling, or both. Similarly, our outcome of reading difficulty does not directly correlate with an individual's actual comprehension of hospital documents. Additional work is needed to confirm how vision impacts actual reading and understanding of hospital documents. Another limitation was that our question regarding going down steps/stairs/curbs dealt with dim lighting or night conditions, and may not represent actual ambulating ability in good lighting conditions.

In summary, vision is limited in a sizeable percentage of recently hospitalized Americans, and poor vision is significantly associated with subjective difficulties in reading and mobility outcomes. The type of poor vision may also be very relevant in actual reading and external mobility outcomes, and further study is needed to determine differences in the functional consequences of VI and URE in hospitalized patients.²⁵ Moreover, future research should focus on developing hospital documents that could be more amenable to those with poor vision, organizing interventions to improve the mobility of those with poor vision, and creating interventions to decrease the fall risk among hospitalized and recently hospitalized individuals with poor vision.

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Figure 1.

Prevalence of poor near and distance vision among recently hospitalized adult Americans, National Health and Nutrition Examination Survey 2001-2008

†Distance visual acuity worse than 20/40 after refraction; ‡Distance visual acuity 20/40 or better after refraction; Error bars represent standard error.

Figure 2.

Prevalence of self-reported functional difficulty by near and distance presenting visual acuity among recently hospitalized adult Americans, National Health and Nutrition Examination Survey 2001-2008; A) Self-reported reading difficulty, B) self-reported difficulty with steps/curbs/stairs, and C) self-reported falling difficulty.

*Presenting near/distance visual acuity better than 20/40; **Presenting near visual acuity worse than 20/40; ***Presenting distance visual acuity worse than 20/40, but refracting to 20/40 or better; ****Presenting distance visual acuity worse than 20/40 after refraction.

Table 1

Characteristics of recently hospitalized adult Americans with incomplete vs complete visual acuity data, National Health and Nutrition Examination Survey 2001-2008^{*}

Variable	Incomplete data (n=382)	Complete data (n=1,347)	P-value
Age, median (95% CI) years	71.4 (68.8-74.0)	66.6 (65.8-67.4)	<0.01
Female sex, % (95% CI)	60.7 (52.9-68.5)	53.6 (50.6-56.6)	0.10
Race/ethnicity, % (95% CI)			0.052
Non-Hispanic white	70.3 (64.1-76.6)	79.0 (74.8-83.2)	
Non-Hispanic black	16.1 (11.7-20.5)	10.3 (7.7-12.8)	
Mexican American	5.6 (2.2-8.9)	3.6 (2.2-4.9)	
Other	8.0 (2.9-13.1)	7.2 (4.6-9.7)	
Medical history, % (95% CI)			
Diabetes	24.9 (16.5-33.2)	24.8 (21.1-28.5)	0.99
Stroke	21.5 (15.7-27.4)	12.7 (10.2-15.1)	<0.01
Arthritis	54.0 (43.1-64.8)	56.4 (52.4-60.5)	0.68
Obesity, % (95% CI)	56.7 (56.0-62.1)	40.9 (37.9-44.0)	<0.01
Smoking history, % (95% CI)			0.37
Non-smoker	47.5 (39.1-55.8)	40.6 (37.3-43.9)	
Former smoker	37.7 (30.8-45.3)	44.0 (41.0-47.1)	
Current smoker	14.8 (7.1-22.5)	15.4 (12.7-18.0)	

CI, confidence interval

^{*} Similar trend with analysis focusing on 2001-2004 data, where self-reported fall data was available

Factors associated with self-reported functional difficulties among recently hospitalized adults in the United States, National Health and Nutrition Examination Survey 2001-2008

Table 2

Variable	Interval	Reading difficulty, OR (95% CI) N=1,347	Reading difficulty, OR (95% CI) N=1,347	Difficulty with steps/curbs/stairs, OR (95% CI) N=1,347	Difficulty with steps/curbs/stairs, OR (95% CI) N=1,347	Falling difficulty, OR (95% CI) N=631	Falling difficulty, OR (95% CI) N=631
LogMAR distance presenting visual acuity	0.3 logMAR units	-	2.60 [*] (1.93-3.49)	-	2.40 [*] (1.88-3.07)	-	1.59 [*] (1.02-2.46)
Poor distance vision [#]	vs normal distance vision	-	3.18 [*] (1.91-5.29)	-	2.98 [*] (1.88-4.75)	-	1.91 (0.90-4.07)
LogMAR near presenting visual acuity	0.3 logMAR units	1.92 [*] (1.55-2.39)	-	1.86 [*] (1.47-2.35)	-	1.28 (0.91-1.79)	-
Poor near vision [#]	vs normal near vision	3.79 [*] (2.43-5.92)	-	4.06 [*] (2.72-6.05)	-	1.96 (0.87-4.38)	-
Age	per year	0.99 (0.97-1.01)	0.98 (0.96-1.00)	1.01 (0.99-1.04)	1.01 (0.93-2.03)	1.01 (0.99-1.03)	1.01 (0.98-1.03)
Female sex	vs male	1.56 [*] (1.10-2.21)	1.46 [*] (1.03-2.07)	1.45 (0.98-2.13)	1.37 (0.93-2.03)	1.60 (0.97-2.64)	1.56 (0.95-2.57)
Race							
Non-Hispanic black	vs non-Hispanic white	1.21 (0.70-2.07)	1.30 (0.78-2.19)	0.94 (0.58-1.52)	0.99 (0.59-1.68)	0.56 (0.26-1.19)	0.55 (0.25-1.21)
Mexican	vs non-Hispanic white	0.99 (0.59-1.66)	0.97 (0.60-1.58)	0.83 (0.43-1.58)	0.81 (0.41-1.59)	0.73 (0.30-1.84)	0.72 (0.29-1.77)
Other	vs non-Hispanic white	1.81 (0.93-3.55)	1.66 (0.91-3.03)	1.32 (0.63-2.76)	1.26 (0.64-2.46)	1.04 (0.38-2.84)	0.97 (0.37-2.59)
College education	vs no college education	0.75 [*] (0.58-0.97)	0.75 [*] (0.59-0.96)	0.89 (0.71-1.13)	0.89 (0.82-1.12)	0.85 (0.58-1.23)	0.84 (0.57-1.25)
Self-reported illness							
Diabetes	vs none	-	-	1.66 [*] (1.18-2.35)	1.58 [*] (1.13-2.22)	2.38 [*] (1.29-4.39)	2.33 [*] (1.25-4.36)
Stroke	vs none	-	-	1.46 (0.92-2.31)	1.58 (0.97-2.61)	4.18 [*] (1.71-10.2)	4.42 [*] (1.91-10.3)
Arthritis	vs none	-	-	1.34 (0.91-1.98)	1.47 (0.98-2.22)	1.87 (0.97-3.61)	2.00 [*] (1.01-3.94)
Obesity	vs none	-	-	1.54 [*] (1.08-2.19)	1.49 [*] (1.06-2.11)	1.58 (0.90-2.75)	1.55 (0.89-2.70)
Smoker							
Former	vs non-smoker	-	-	1.00 (0.66-1.52)	1.01 (0.67-1.51)	0.78 (0.39-1.56)	0.77 (0.39-1.50)
Current	vs non-smoker	-	-	2.35 [*] (1.32-4.19)	2.58 [*] (1.38-4.57)	1.65 (0.65-4.18)	1.70 (0.63-4.64)

OR, odds ratio; CI, confidence interval; logMAR, logarithm of the minimum angle of resolution

[AU: why are there two columns for each difficulty?]

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* P<0.05

Better-eye presenting distance visual acuity worse than 20/40; these variables were not included in the same multivariate regression models as those with logMAR presenting visual acuity variables, however, we adjusted for the remaining variables.

[‡]Data from NHANES 2001-2004

Table 3

Uncorrected refractive error, visual impairment, and self-reported functional difficulties among recently hospitalized adults in the United States, National Health and Nutrition Examination Survey 2001-2008

Variable	Interval	Reading difficulty, adjusted OR [#] (95% CI) N=1,347	Difficulty with steps/ curbs/stairs, adjusted OR ^{##} (95% CI) N=1,347	Falling difficulty, adjusted OR ^{##} (95% CI) N=631
Uncorrected refractive error ^{††}	vs normal distance vision [†]	1.72 (0.92-3.22)	1.33 (0.60-2.97)	2.32 [*] (1.02-5.28)
Visual impairment ^{†††}	vs normal distance vision [†]	7.72 [*] (3.52-16.91)	9.60 [*] (5.37-17.17)	1.15 (0.38-3.47)
Age	per year	0.98 (0.96-1.00)	1.01 (0.98-1.03)	1.02 (0.99-1.04)
Female sex	vs male	1.53 [*] (1.07-2.18)	1.48 [*] (1.07-2.19)	1.62 (0.98-2.69)
Race				
Non-Hispanic black	vs non-Hispanic white	1.29 (0.77-2.16)	0.99 (0.59-1.64)	0.64 (0.29-1.40)
Mexican	vs non-Hispanic white	1.00 (0.60-1.68)	0.87 (0.44-1.73)	0.81 (0.33-2.00)
Other	vs non-Hispanic white	1.79 (0.96-3.33)	1.33 (0.63-2.80)	0.95 (0.34-2.62)
College education	vs no college education	0.72 [*] (0.59-0.96)	-	-
Self-reported illness				
Diabetes	vs none	-	1.82 [*] (1.28-2.57)	2.46 [*] (1.32-4.61)
Stroke	vs none	-	1.69 [*] (1.05-2.73)	4.51 [*] (1.94-10.49)
Arthritis	vs none	-	1.44 (1.00-2.09)	2.00 [*] (1.01-3.95)
Obesity	vs none	-	1.57 [*] (1.12-2.20)	1.52 (0.89-2.59)
Smoker				
Former	vs non-smoker	-	1.03 (0.69-1.53)	0.77 (0.39-1.55)
Current	vs non-smoker	-	2.77 [*] (1.57-4.87)	1.73 (0.66-4.54)

[†]Presenting visual acuity 20/40 or better

^{††}Presenting visual acuity worse than 20/40, but refracting to 20/40 or better

^{†††}Visual acuity worse than 20/40 after refraction

^{*}P<0.05

[#]Adjusted for visual acuity, age, sex, race, and education

^{##}Adjusted for vision, age, sex, race, education, obesity, smoking, and self-reported diabetes/stroke/arthritis