



## Health literacy and vision-related quality of life

Kelly W Muir, Cecilia Santiago-Turla, Sandra S Stinnett, Leon W Herndon, Rand Allingham, Pratap Challa and Paul P Lee

*Br. J. Ophthalmol.* published online 6 May 2008;  
doi:10.1136/bjo.2007.134452

---

Updated information and services can be found at:  
<http://bjournal.bmj.com/cgi/content/abstract/bjo.2007.134452v1>

---

*These include:*

### Rapid responses

You can respond to this article at:  
<http://bjournal.bmj.com/cgi/eletter-submit/bjo.2007.134452v1>

### Email alerting service

Receive free email alerts when new articles cite this article - sign up in the box at the top right corner of the article

---

### Notes

---

**Online First** contains unedited articles in manuscript form that have been peer reviewed and accepted for publication but have not yet appeared in the paper journal (edited, typeset versions may be posted when available prior to final publication). Online First articles are citable and establish publication priority; they are indexed by PubMed from initial publication. Citations to Online First articles must include the digital object identifier (DOIs) and date of initial publication.

---

To order reprints of this article go to:  
<http://journals.bmj.com/cgi/reprintform>

To subscribe to *British Journal of Ophthalmology* go to:  
<http://journals.bmj.com/subscriptions/>

Health literacy and vision-related quality of life

Kelly W. Muir, MD; Cecilia Santiago-Turla, MD; Sandra S. Stinnett, DrPH; Leon W. Herndon, MD; R. Rand Allingham, MD, Pratap Challa, MD and Paul P. Lee, MD, JD

Duke University Eye Center, Durham, NC 27710

Corresponding author:

Kelly W. Muir, MD

Duke University Medical Center, Box 3802

Durham, NC 27710

Phone: (919) 684-3283

Fax: (919) 681-8267

[kelly.muir@duke.edu](mailto:kelly.muir@duke.edu)

Presented at the American Academy of Ophthalmology Annual Meeting,  
November, 2006.

Keywords: quality of life, glaucoma, health literacy

Word count, excluding title page, references and tables: 1890

## **ABSTRACT**

**Background:** Non-visual factors influence a person's vision-related quality of life (VRQoL). The purpose of this study was to assess the relationship between health literacy and VRQoL in glaucoma patients.

**Methods:** One hundred ninety-five subjects with open-angle glaucoma participated in a cross-sectional patient survey and chart review. Subjects were administered a test of health literacy, an assessment of physical and mental well-being, and an assessment of VRQoL, the National Eye Institute 25-Item Visual Function Questionnaire (VFQ-25). Charts were reviewed for visual acuity and visual field results.

**Results:** In univariate analyses, older age ( $p < 0.001$ ), non-White race ( $p < 0.001$ ), worse visual acuity ( $p < 0.001$ ), worse visual field scores ( $p < 0.001$ ), lower level of education ( $p < 0.001$ ), worse health literacy ( $p < 0.001$ ) and worse score on the mental health component of the SF-12 ( $p = 0.005$ ) were associated with worse VFQ-25 scores. In multivariate analyses, only older age was associated with worse total VFQ-25 scores ( $p < 0.001$ ), although the association between health literacy and the VFQ subscale of dependency remained significant ( $p = 0.04$ ).

**Conclusions:** Individuals with lower health literacy do not appear to have worse overall VRQoL compared to those with higher literacy, but worse health literacy is associated with increased dependency.

## INTRODUCTION

The National Adult Literacy Survey of 1992, the most comprehensive assessment of English-language literacy in the United States to date, revealed that nearly one fourth of the American adult population is functionally illiterate.<sup>1</sup> The prevalence of inadequate health literacy (the inability to comprehend written material in a health care setting), is even greater. In one study involving 2659 patients in two urban hospitals, 42% of subjects were unable to understand written instructions for taking medication on an empty stomach. Overall, 35% of the English-speaking and 62% of the Spanish-speaking subjects demonstrated inadequate or marginal health literacy.<sup>2</sup> In a sample of patients with open angle glaucoma, we reported that 52% read at or below an eighth grade reading level and 12% read at a level of third grade or below.<sup>3</sup>

Poor health literacy impacts patients in multiple ways. Less literate patients are more likely to be hospitalized than their more literate peers.<sup>4</sup> We found that glaucoma patients who read at a ninth grade level or above refilled their prescribed medication more frequently over a six month period than patients who read at an eighth grade level or below.<sup>3</sup> Rates of hospitalizations and medication adherence are important measures of care, but do not directly address issues of primary concern to patients, such as quality of life. A recent study demonstrated that poor health literacy is associated with more depressive symptoms.<sup>5</sup> Patients with glaucoma are known to express lower vision-related quality of life (VRQoL) than patients of similar age without glaucoma,<sup>6</sup> but the nonvisual contributors to this discrepancy remain unclear. As such, we investigated whether glaucoma patients with lower health literacy would describe worse VRQoL.

## METHODS

The study, approved by the Duke University Institutional Review Board, was designed as a cross-sectional patient survey and concomitant chart review. Potential subjects were recruited from the Glaucoma Service of Duke University Eye Center. Inclusion criteria included a diagnosis of open-angle glaucoma and presence of visual field tests in the medical record. Subjects who refused to participate or scored less than 18 on the Mini Mental State Exam (MMSE,) a measurement of cognitive status,<sup>7</sup> were excluded. From July 2000 through June 2001, 209 potential subjects were approached in the Duke University Eye Center while waiting to see a glaucoma specialist and asked to participate in the survey. Informed consent was obtained for survey participation as well as for review of the medical record. All subjects were approached and all surveys were conducted by the same investigator (CST). The survey included questions relating to demographic data (self-reported race and level of education completed), the MMSE, the Rapid Assessment of Adult Literacy in Medicine (REALM),<sup>8</sup> the National Eye Institute 25-Item Visual Function Questionnaire (VFQ-25),<sup>9</sup> and the 12-item Short Form Health Survey (SF-12),<sup>10</sup> an assessment of general health-related quality of life (HRQoL). Both the VFQ-25<sup>11</sup> and the SF-12<sup>12</sup> have been validated in subjects with glaucoma. The VFQ-25 addresses 12 subscales: general health, general vision, near vision, distance vision, driving,

peripheral vision, color vision, ocular pain, role limitations, dependency, social function, and mental health. Answers to each question on the VFQ-25 are converted to a 100-point scale in which 100 represents the best possible score and 0 represents the worst.<sup>9 11</sup> SF-12 is the shorter version of the Short-Form survey 36 (SF-36). SF-12 includes questions on 8 domains: physical functioning, role limitations because of physical health problems, bodily pain, general health, vitality, social functioning, role limitations because of emotional health problems and mental health. These domains are used to compute the physical component score (PCS) and mental component score (MCS), which ranges from 0 to 100. A higher score denotes better HRQL.<sup>10</sup> The REALM is a reading recognition test composed of 66 health-related words which can be scored to estimate literacy level as follows: 0 to 18,  $\leq$ 3rd grade; 19 to 44, 4th to 6th grade; 45 to 60, 7th to 8th grade; and 61 to 66,  $\geq$ 9th grade.<sup>8</sup> The medical record was reviewed for visual acuity (as measured at the clinic visit on the same day as the survey was performed) and the most recent visual field results.

### Statistical Methods

Initially, descriptive statistics were obtained, (means, standard deviations, medians for continuous data and frequencies and percentages for categorical data). The relationship between quality of life (measured by both the VFQ-25 and the SF-12) and demographic (age, sex, race, education, and grade level) and vision variables (visual acuity and mean deviation of visual field) was assessed in a univariate fashion using either a analysis of variance (for categorical predictors) or linear regression (for continuous predictors). Predictors known to contribute to VRQoL such as age,<sup>13</sup> visual acuity and visual field<sup>6 14 15</sup>, and SF-12 score (as a surrogate for existence of comorbid conditions.)<sup>16</sup> were combined in multivariate regression models to assess their joint effects on quality of life. The model used for the primary analysis included as explanatory variables both level of education reported and health literacy as measured by the REALM test because measured literacy is shown to fall short of what would be expected according to duration of formal education.<sup>2</sup> Although literacy and education are not interchangeable, the two measures are correlated, so a second analysis of total VFQ score was developed, excluding level of education reported as an explanatory variable.

### RESULTS

Of the 209 subjects approached, nine declined to participate in the complete survey, including seven women and two men, six blacks, two whites and one subject of unknown race. Five subjects did not meet the MMSE criteria with scores of three, five and 10, 13 and 15. These subjects were all men ranging in age from 71 to 90 years and included two whites, two blacks and one subject of unknown ethnicity. Characteristics of the 195 subjects who completed the survey are presented in Table 1.

TABLE 1

**Univariate Analysis of Factors Associated with Vision-related Quality of Life in 195 Subjects with Open Angle Glaucoma**

Variable	N (%)	VFQ-25* Mean (standard deviation); median	P value**
<b>Race</b>			<0.001
White	108 (55)	84 (17); 89	
Black	82 (42)	75 (19); 78	
Asian/Pacific Islander	2 (1)		
Latino	2 (1)		
Unknown	1 (.5)		
<b>Gender</b>			0.280
Male	79 (41)	82 (17); 88	
Female	116 (59)	79 (19); 86	
<b>Age (years)</b>			<0.001
≤ 65	56 (28)	86 (14); 91	
66-73	43 (22)	81 (18); 87	
74-80	51 (26)	79 (20); 87	
>80	45 (23)	72 (19); 73	
<b>Visual Field<sup>^</sup> [slope (standard error)] (N=110)</b>		1.42 (0.155)	<0.001
<b>Visual Acuity<sup>^</sup> [slope (standard error)]</b>		-27.44 (3.37)	<0.001
<b>Education</b>			<0.001
Did not complete high school	49 (25)	75 (18); 79	
High school graduate	145 (75)	82 (18); 89	
<b>Health literacy</b>			<0.001
REALM <sup>s</sup> score			
≤ 8 <sup>th</sup> grade level	100 (52)	76 (18); 81	
≥ 9 <sup>th</sup> grade level	94 (48)	84 (18); 90	
<b>General Health (SF-12<sup>†</sup>) [slope (standard error)]</b>			0.005
Mental Health Component		0.19 (0.07)	
Physical Health Component		0.08 (0.05)	
			0.102

\*VFQ-25 = Visual Function Questionnaire - 25.

\*\*P-values based on Wilcoxon rank sum test for comparison among categories of variables or t-tests for slopes

^Mean deviation in the visual field of the better-seeing eye. For every decibel increase in mean deviation, VFQ increases by 1.42 points.

^^Visual acuity in the better-seeing eye. For every one logMAR unit increase in visual acuity, VFQ worsens by 27.4 points.

§REALM = Rapid Assessment of Adult Literacy in Medicine

¶ SF-12 = 12-item Short Form Health Survey

In a univariate analysis of factors associated with total VFQ-25 scores as a measure of vision-related quality of life, older age ( $p<0.001$ ), non-White race ( $p<0.001$ ), worse visual acuity ( $p<0.001$ ) and visual field scores ( $p<0.001$ ), lower level of education ( $p<0.001$ ), worse health literacy ( $p<0.001$ ) and worse score on the mental health component of the SF-12 ( $p=0.005$ ) were associated with worse total VFQ-25 scores (Table 1). In a multivariate analysis using visual acuity and visual field parameters from the better-seeing eye, only older age retained an association with worse total VFQ score ( $p<0.001$ ), although worse visual field reached borderline significance ( $p=0.051$ , Table 2). In a multivariate analytical model which excluded education (due to the correlation between education and health literacy,) likewise, health literacy was not associated with VRQoL ( $p=0.946$ ). In the multivariate analysis of factors associated with the subscale components of the VFQ, poor health literacy was associated only with dependency ( $p=0.040$ , Table 2).

TABLE 2

### Multivariate Analysis of Factors Associated with Vision-related Quality of Life as Judged by the Visual Function Questionnaire (VFQ) Total Score and Subscales

Variable	Total VFQ score		Color Vision	Distance tasks	Dependency	Driving	General Health	General Vision
	Slope (SE)*	P-value	P-value	P-value	P-value	P-value	P-value	P-value
Age (continuous)	-0.112 (0.192)	<0.001	0.709	0.195	0.739	0.001	0.005	0.676
Race (White vs. NonWhite)	-2.435 (4.150)	0.559	0.735	0.790	0.133	0.870	0.035	0.309
Visual acuity**	-1.416 (10.162)	0.890	0.032	0.054	0.012	0.053	0.876	0.002
Visual field^	0.514 (0.260)	0.051	0.075	<0.001	<0.001	<0.001	0.051	<0.001
Health literacy (REALM^^ score: $\leq$ 8 <sup>th</sup> grade vs. $\geq$ 9 <sup>th</sup> grade)	-2.180 (4.403)	0.621	0.216	0.857	0.040	0.195	0.541	0.654
Education (highschool graduate vs not)	-5.223 (5.346)	0.331	0.089	0.232	0.312	0.069	0.665	0.566
General Health (SF-12 <sup>§</sup> )								
Mental	0.232 (0.130)	0.077	0.196	0.329	0.271	0.462	0.263	0.168
Physical	-0.010 (0.092)	0.913	0.726	0.229	0.639	0.035	<0.001	0.107
<b>Variable</b>			<b>Mental Health</b>	<b>Near Tasks</b>	<b>Ocular Pain</b>	<b>Peripheral Vision</b>	<b>Role Limitations</b>	<b>Social Function</b>
			P-value	P-value	P-value	P-value	P-value	P-value
Age (continuous)			0.976	0.966	0.045	0.486	0.755	0.603
Race (White vs Nonwhite)			0.712	0.907	0.350	0.262	0.914	0.648
Visual acuity**			0.012	0.001	0.571	0.027	<0.001	0.217
Visual field^			0.005	<0.001	0.046	0.001	<0.001	<0.001
Health literacy (REALM <sup>§</sup> score: $\leq$ 8 <sup>th</sup> grade vs. $\geq$ 9 <sup>th</sup> grade)			0.646	0.271	0.538	0.723	0.656	0.926
Education (highschool graduate vs not)			0.600	0.649	0.768	0.548	0.575	0.248
General Health (SF-12 <sup>§</sup> )								
Mental			0.005	0.860	0.548	0.400	0.470	0.764
Physical			0.234	0.292	0.134	0.522	0.969	0.103

Only 110 of 195 subjects were included in the multivariate analysis due to missing values for some variables.

\*SE = Standard Error

\*\*Visual acuity in the better-seeing eye

^Mean deviation in the visual field of the better-seeing eye

^^REALM = Rapid Assessment of Adult Literacy in Medicine

§ SF-12 = 12-item Short Form Health Survey (Mental Health and Physical Health components described separately)

In a univariate analysis of factors associated with general health-related quality of life as judged by the SF-12 questionnaire, non-White race ( $p=0.039$ ), lower level of education ( $p<0.001$ ), age ( $p=0.043$ ) and worse health literacy ( $p=0.002$ ) were associated with worse physical HRQoL scores. Gender ( $p=0.666$ ), visual acuity ( $p=0.886$ ), and visual field ( $p=0.109$ ) were not associated with physical health-related quality of life scores. The SF-12 questionnaire indicated that mental HRQoL was associated with level of education ( $p=0.001$ ), non-White race ( $p=0.010$ ), gender ( $p=0.039$ ), but not age ( $p=0.341$ ), health literacy ( $p=0.068$ ), visual acuity ( $p=0.886$ ), or visual field ( $p=0.174$ ).

## DISCUSSION

Vision-related quality of life is negatively impacted not only by poor vision,<sup>6</sup><sup>14 15</sup> but by older age,<sup>13</sup> comorbid conditions such as depression,<sup>16</sup> and socioeconomic factors such as low income.<sup>13</sup> Lower income is associated with lower health literacy,<sup>17</sup> and we hypothesized that lower health literacy may be associated with worse VRQoL. We found that poor health literacy is only weakly associated with worse VRQoL in patients with glaucoma. The association between poor health literacy and worse VRQoL was found in the univariate model but disappeared in the multivariate model. But this is not to say that poor health literacy may not have an indirect effect on VRQoL. We have shown previously that poor health literacy is associated with poor medication adherence in patients with glaucoma.<sup>3</sup> Although we lack direct evidence to support the claim that poor medication adherence negatively impacts clinical outcomes in glaucoma, multiple studies have shown that lowering of intraocular pressure reduces the risk of glaucomatous visual loss,<sup>18 19</sup> and glaucomatous visual loss is associated with worse HRQoL.<sup>6 15 20-22</sup>

It is interesting to note, however, that in a multivariate analysis, even when controlling for general health parameters, health literacy is related to the dependency subscale of the VFQ-25. It may be that those of lower literacy have less resources or ability to compensate for the impact of poorer vision. Because lower literacy is strongly associated with lower socioeconomic status (and thus resources) in the United States, we cannot say if lower literacy works directly through the ability to understand and use available services or if it works indirectly through fewer economic resources to help offset the impact of poor vision.

The analysis of the impact of health literacy on general HRQoL, as measured by the SF-12 physical and mental components demonstrates that, at least in univariate analyses, health literacy is related to at least the physical component score. While the mental component score is not statistically significantly related ( $p = 0.07$ ), this may be a reflection of the sample size here as opposed to the lack of a true relationship. Given the impact of reduced health literacy on depressive symptoms<sup>5</sup> and the strong relationship of symptoms to HRQoL scores such as the SF-36,<sup>23</sup> there may well be an association that is present.

This study is limited by the sample size of the patients studied. It is further limited by the single practice nature of the patients enrolled, coming from an academic health practice in the southeastern United States. Having larger numbers of patients from a broader geographic region would be important to be able to generalize the findings of the study. Third, the patients included only those who have open-angle glaucoma and are under continuing care for the condition, with the vast majority receiving chronic topical therapy with eye drops. As such, it also represents a select population, since many patients with glaucoma do not maintain regular follow-up care.<sup>24</sup>

As we strive to focus research on patient-centered outcomes such as quality of life, it is helpful to clarify the contributory role of socioeconomic factors. This study demonstrates that once visual acuity and visual field in the better eye are included, health literacy is no longer significantly associated with total VFQ-25 scores, while it is related to at least one subscale. As such, health literacy may be useful to consider for inclusion in future analyses. At the very least, this study begins to provide additional information about how health literacy may impact outcomes in glaucoma.

Funding: Research to Prevent Blindness, the Carr family, and an unrestricted grant from Pfizer. The funding organizations had no role in the design or conduct of this research.

Competing interests: None declared.

#### Licence for Publication

The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, an exclusive licence (or non exclusive for government employees) on a worldwide basis to the BMJ Publishing Group Ltd to permit this article (if accepted) to be published in BJO and any other BMJPGJL products and sublicences such use and exploit all subsidiary rights, as set out in our licence (<http://bjo.bmj.com/ifora/licence.pdf>).

## REFERENCES

1. Kirsch I, Jungeblut, A., Jenkins, L., Kolstad, A. . Adult literacy in America: A first look at the findings of the National Adult Literacy Survey. Washington, DC: National Center for Education Statistics, US Department of Education, 1993.
2. Williams MV, Parker RM, Baker DW, Parikh NS, Pitkin K, Coates WC, et al. Inadequate functional health literacy among patients at two public hospitals. *Jama* 1995;274(21):1677-82.
3. Muir KW, Santiago-Turla C, Stinnett SS, Herndon LW, Allingham RR, Challa P, et al. Health literacy and adherence to glaucoma therapy. *Am J Ophthalmol* 2006;142(2):223-6.
4. Baker DW, Parker RM, Williams MV, Clark WS. Health literacy and the risk of hospital admission. *J Gen Intern Med* 1998;13(12):791-8.
5. Lincoln A, Paasche-Orlow MK, Cheng DM, Lloyd-Travaglini C, Caruso C, Saitz R, et al. Impact of health literacy on depressive symptoms and mental health-related: quality of life among adults with addiction. *J Gen Intern Med* 2006;21(8):818-22.
6. Gutierrez P, Wilson MR, Johnson C, Gordon M, Cioffi GA, Ritch R, et al. Influence of glaucomatous visual field loss on health-related quality of life. *Arch Ophthalmol* 1997;115(6):777-84.
7. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975;12(3):189-98.
8. Davis TC, Long SW, Jackson RH, Mayeaux EJ, George RB, Murphy PW, et al. Rapid estimate of adult literacy in medicine: a shortened screening instrument. *Fam Med* 1993;25(6):391-5.
9. Mangione CM, Lee PP, Gutierrez PR, Spritzer K, Berry S, Hays RD. Development of the 25-item National Eye Institute Visual Function Questionnaire. *Arch Ophthalmol* 2001;119(7):1050-8.
10. Ware J, Jr., Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996;34(3):220-33.
11. Mangione CM, Lee PP, Pitts J, Gutierrez P, Berry S, Hays RD. Psychometric properties of the National Eye Institute Visual Function Questionnaire (NEI-VFQ). NEI-VFQ Field Test Investigators. *Arch Ophthalmol* 1998;116(11):1496-504.
12. Knudtson MD, Klein BE, Klein R, Cruickshanks KJ, Lee KE. Age-related eye disease, quality of life, and functional activity. *Arch Ophthalmol* 2005;123(6):807-14.
13. Broman AT, Munoz B, West SK, Rodriguez J, Sanchez R, Snyder R, et al. Psychometric properties of the 25-item NEI-VFQ in a Hispanic population: Proyecto VER. *Invest Ophthalmol Vis Sci* 2001;42(3):606-13.

14. Hyman LG, Komaroff E, Heijl A, Bengtsson B, Leske MC. Treatment and vision-related quality of life in the early manifest glaucoma trial. *Ophthalmology* 2005;112(9):1505-13.
15. Nelson P, Aspinall P, Pappasoulotis O, Worton B, O'Brien C. Quality of life in glaucoma and its relationship with visual function. *J Glaucoma* 2003;12(2):139-50.
16. Owsley C, McGwin G, Jr. Depression and the 25-item National Eye Institute Visual Function Questionnaire in older adults. *Ophthalmology* 2004;111(12):2259-64.
17. Gazmararian JA, Baker DW, Williams MV, Parker RM, Scott TL, Green DC, et al. Health literacy among Medicare enrollees in a managed care organization. *Jama* 1999;281(6):545-51.
18. Lichter PR, Musch DC, Gillespie BW, Guire KE, Janz NK, Wren PA, et al. Interim clinical outcomes in the Collaborative Initial Glaucoma Treatment Study comparing initial treatment randomized to medications or surgery. *Ophthalmology* 2001;108(11):1943-53.
19. Kass MA, Heuer DK, Higginbotham EJ, Johnson CA, Keltner JL, Miller JP, et al. The Ocular Hypertension Treatment Study: a randomized trial determines that topical ocular hypotensive medication delays or prevents the onset of primary open-angle glaucoma. *Arch Ophthalmol* 2002;120(6):701-13; discussion 829-30.
20. Broman AT, Munoz B, Rodriguez J, Sanchez R, Quigley HA, Klein R, et al. The impact of visual impairment and eye disease on vision-related quality of life in a Mexican-American population: proyecto VER. *Invest Ophthalmol Vis Sci* 2002;43(11):3393-8.
21. Parrish RK, 2nd, Gedde SJ, Scott IU, Feuer WJ, Schiffman JC, Mangione CM, et al. Visual function and quality of life among patients with glaucoma. *Arch Ophthalmol* 1997;115(11):1447-55.
22. Wilson MR, Coleman AL, Yu F, Bing EG, Sasaki IF, Berlin K, et al. Functional status and well-being in patients with glaucoma as measured by the Medical Outcomes Study Short Form-36 questionnaire. *Ophthalmology* 1998;105(11):2112-6.
23. Lee PP, Spritzer K, Hays RD. The impact of blurred vision on functioning and well-being. *Ophthalmology* 1997;104(3):390-6.
24. Ostermann J, Sloan FA, Herndon L, Lee PP. Racial differences in glaucoma care: the longitudinal pattern of care. *Arch Ophthalmol* 2005;123(12):1693-8.