Published in final edited form as:

Ophthalmic Epidemiol. 2017 June ; 24(3): 174–180. doi:10.1080/09286586.2016.1257027.

Multivariable Regression Model of the EuroQol 5-Dimension Questionnaire in Patients Seeking Outpatient Low Vision Rehabilitation

Alexis G. Malkin^a, Judith E. Goldstein^b, Robert W. Massof^{fb}, Low Vision Research Network Study Group*

^aNew England College of Optometry, Boston, MA, USA;

^bJohns Hopkins University School of Medicine, Baltimore, MD, USA

Abstract

Purpose: To understand the source of between-person variance in baseline health utilities estimated from EuroQol 5-dimension questionnaire (EQ-5D) responses of a representative sample of the US low vision outpatient population prior to rehabilitation.

Methods: A prospective, observational study of 779 new low vision patients at 28 clinic centers in the US. The EQ-5D, Activity Inventory (AI), Telephone Interview for Cognitive Status (TICS), Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) physical functioning component, and Geriatric Depression Scale (GDS) were administered by telephone interview prior to rehabilitation. EQ-5D responses were transformed into health utilities, which served as the dependent variable in all analyses. Data were then analyzed to determine how much overall visual ability, functional domains of visual ability, and comorbidities (e.g. physical functioning, depression, cognition) independently contribute to the EQ-5D-based health utility index.

Results: Multivariable regression analyses showed that the GDS and SF-36 physical account for nearly 40% of the variance observed in health utilities estimated from EQ-5D responses of low vision patients. Age was also a significant predictor of health utilities, but accounted for very little variance. None of the other variables were significant predictors.

Conclusions: Health utilities of low vision patients estimated from the EQ-5D primarily are associated with comorbid factors that are not likely to be responsive to low vision rehabilitation, thereby rendering the EQ-5D an unsuitable outcome measure for this population. However, because the EQ-5D is responsive to comorbid states, it could be a useful tool for evaluating the impact of comorbidities on low vision patient quality of life.

Keywords

Depression; health utilities; quality of life; visual impairment

CONTACT Alexis G. Malkin, OD malkina@neco.edu New England College of Optometry, 424 Beacon Street, Boston, MA 02115, USA. Tel: +1 781 596 2502 x 2782. Fax: +1 781 595 1540.

*See Ref. 19 for members of the Low Vision Research Network Study Group.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the writing and content of this article.

Introduction

The United States population is aging; consequently, there will be an increasing incidence and prevalence of age-related eye diseases and low vision.^{1,2} Age-related macular degeneration (AMD) is a major cause of low vision in adults over 75 years in the US. Additional causes include cataract, glaucoma, and diabetic retinopathy. Vision loss affects many aspects of daily living³⁻⁵ including reading, driving, mobility, medication management, and other activities that must be performed to live independently and enjoy good quality of life. Although in some cases there are treatments to prevent disease progression, most age-related eye diseases do not have treatments that completely restore vision. Vision rehabilitation is focused on improving overall visual ability, the ability to perform activities that depend on vision, by teaching patients adaptations to help them compensate for their visual impairment. Vision rehabilitation can have a significant impact on the patient's visual ability and in turn can positively impact his/her quality of life. Past studies have demonstrated the effectiveness of low vision rehabilitation (LVR) using patient-reported functional outcome measures.⁶⁻⁸

Incorporation of patient-reported outcome measures is now strongly recommended (and in many cases required⁹) in clinical research. This trend has stemmed from recommendations of the US Panel on Cost Effectiveness^{10,11} as well as similar panels outside of the US.¹² A main consideration in using patient-reported outcome measures is the ability to compare benefits of treatments across different health care disciplines and in this way to compare cost-effectiveness of different treatment strategies. In order to make these comparisons, measures need to be expressed in the same units. The universal measure of cost-effectiveness is cost per quality-adjusted life year (QALY) gained. Health utilities are incorporated in these estimates. The standard methods of directly measuring utilities are the time trade off (TTO) and the standard gamble (SG). Both the TTO and SG are difficult to administer and are not easily understood by patients. Both of these measures ask subjects to imagine a hypothetical scenario regarding their current health state, life expectancy and interventions that may change this health state. This hypothetical scenario can be difficult for subjects to relate to their actual life experiences. To simplify the process of measuring utilities, a number of rating scale questionnaires have been developed that map combinations of patient responses to health utilities so that researchers can use them in their clinical studies to indirectly estimate health utility from ratings of items. However, the rating scale questionnaires need to be responsive to the types of health state improvements being targeted in the clinical studies.

The EuroQol 5-Dimension questionnaire (EQ-5D) is an example of a rating scale questionnaire designed to measure quality of life. The five domains of the EQ-5D are usual activities, self-care, mobility, pain, and depression.¹³ Each unique response combination defines a health state and is mapped onto a health utility estimated from TTO scores for that combination of EQ-5D item responses. Once mapped, it is then possible to estimate utilities from EQ-5D responses, which is simpler and less time consuming than administering a TTO or SG on all patients in a research study.

Vision-related quality of life cannot always be measured with the same instruments as health-related quality of life due to the distinct impact of ocular disorders on visual functioning. Vision-specific instruments have been developed, but these cannot be directly compared to the general health instruments because they are not in the same units. One of the challenges is developing an instrument that can be used for both vision and general health; that is, the instrument needs to be sensitive enough to respond to changes in the patient's overall visual ability, but also general enough to be responsive to the overall health state.

The EQ-5D includes questions about a person's general health and four of the five questions (major areas of daily life) reasonably could be impacted when there is visual impairment. We expect vision to factor in all domains except pain. The existing literature supports this expectation by demonstrating that the EQ-5D utility in the visually impaired population averages significantly <1 (i.e. the population demonstrates reduced quality of life).^{14,15}

However, we recently demonstrated that the EQ-5D was not responsive to the effects of LVR even when significant changes were measured with the Activity Inventory (AI, a visual function-targeted outcome measure).¹⁵ The EQ-5D utility change scores were not significantly different from 0 after rehabilitation, whereas the AI showed a moderate size effect in overall visual ability (goals) after rehabilitation. Furthermore, the EQ-5D at baseline was not normally distributed and it did not discriminate between varying levels of visual acuity and visual ability. Tosh and colleagues¹⁴ and Bozzani and colleagues¹⁶ demonstrated similar findings when evaluating patients with AMD and glaucoma, respectively. In these studies, the EQ-5D was able to differentiate between those with and without an ocular condition, but not in the degree of severity of the condition. This is consistent with findings in diabetic retinopathy and diabetic macular edema as well.¹⁷ Alavi and co-workers¹⁸ showed a moderate to strong negative correlation between utility values and visual measures (binocular visual acuity and integrated visual field results) in glaucoma patients with a similar amount of variance left unexplained. Previous studies have offered theories for the cause of variance but none have performed this assessment in a low vision population where the analysis is not disorder dependent.

The EQ-5D has limited sensitivity in many ocular conditions, but it was the failures of the EQ-5D specifically as a low vision outcome measure that motivated the present analysis. The present analysis has the aim of better understanding the source of variance/lack of responsiveness in the EQ-5D for the low vision population. Patients presenting to low vision centers across the US tend to be older and have comorbid conditions typical of a geriatric population.¹⁹ It is possible that these comorbidities play a major role in determining the low vision patient's quality of life as measured by the EQ-5D.

This study was designed to look at the distribution of utilities estimated from the EQ-5D before intervention. The aim of this study was to understand the source of the between-person variance in EQ-5D responses in a sample of subjects with vision impairment. This study included measures of physical functioning, cognition, and psychological state, which describe the patient's overall health state. Depression, cognitive status, and significant physical limitations could all impact the patient's quality of life. The presence of these other

conditions could confound our ability to ascertain how vision impairment independently affects this quality of life measure.

Materials and methods

Subjects

The patient sample for this study was 779 new low vision patients from 28 clinical centers throughout the US who participated in the Low Vision Rehabilitation Outcomes Study.⁸ Inclusion criteria were the following: Age 18 years or older, new patient to the participating low vision center (no previous low vision visits in the past 3 years), ability to answer survey questions in English over the phone. The data were collected over a 3-year period from 2008–2011. There were no other inclusion or exclusion criteria.

Procedures

Oral consent was obtained over the telephone by Johns Hopkins University research staff. A series of questionnaires was administered in 1 or 2 telephone interviews before the initial clinical examination. After the initial examination, clinicians uploaded clinical data that included visual acuity, contrast sensitivity, visual field and disorder diagnosis codes. All telephone interview data for this study were collected prior to the baseline low vision clinic visit.⁸ Additional data were collected and have been described in other papers from this study group.^{5,15,20,21}

The study and consent procedures were approved by the Johns Hopkins University Institutional Review Board (IRB). When applicable, the other clinical centers also received approval from their institutions' IRBs. The study adhered to the tenets of the Declaration of Helsinki. All study sites complied with the Health Insurance Portability and Accountability Act.

In addition to the EQ-5D,¹³ the telephone interview included the AI,² the Telephone Interview for Cognitive Status (TICS),²³ the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) physical functioning component,²⁴ and the Geriatric Depression Scale (GDS).²⁵ The AI is an adaptive visual function questionnaire that generates measures of visual ability and has been shown to be responsive to the effects of LVR.⁸ The SF-36 physical is a subset of items in the SF-36 that provides a measure of physical functioning ability. The GDS generates a measure of depressed mood, which has been used extensively in geriatric research. The TICS was used because it is a validated tool for assessing cognitive impairments without requiring performance of vision-dependent tasks. Finally, the EQ-5D was included to estimate health utility.

In order to estimate continuous variables for the instruments used, Rasch analysis, using the Andrich rating scale model²⁶ (Winsteps version 3.65²⁷) was performed on the baseline AI responses. The AI is made up of the functional domains reading, mobility, visual information, and visual motor function. Reading function is estimated from the difficulty ratings of reading tasks using the Andrich model. The same is true for mobility, visual information and visual motor function. Overall visual ability is estimated from the difficulty ratings of the AI activity goals. Rasch analysis was also performed on the responses to the

GDS and SF-36 physical. It was not performed on the TICS responses because the raw scores were heavily skewed toward the ceiling. Therefore, raw scores of the TICS were used instead, which previously have been shown to be monotonic with person measures estimated with the Rasch model.²⁸ This study transformed EQ-5D responses to health utility indices, which served as the dependent variable in all analyses.²⁹ The data were then analyzed to determine how much overall visual ability, functional domains, and comorbidities (e.g. physical functioning, depression, cognition) independently contribute to the EQ-5D score, and thus to the general health utility measure.

In this study, the independent variables analyzed with multivariable regression models were age, physical functioning (SF-36), depression (GDS), cognition (TICS), visual ability (AI goals), the AI functional domains of reading, mobility, visual information and visual motor function, and visual acuity (a continuous logarithm of the minimum angle of resolution, LogMAR, scale). The health utility index estimated from EQ-5D responses was the dependent variable in each of these models. Pearson correlations were used to evaluate covariates for the purpose of identifying which factors were not likely to compete as strong predictors in the model because of their covariances with other factors. Systat (Systat, San Jose, CA, USA) was used for analyses with the multivariate regression model.

Results

Descriptive data for subjects are listed in Table 1. The subjects in the study were older (median age 77 years), the majority were female, and over half had moderate to severe visual impairment. Macular diseases accounted for 55% of all diagnoses reported in the study. Non-neovascular AMD was reported in 26% of all patients and neovascular AMD was reported in another 12%. Additional details on patient characteristics can be found in the summary article by Goldstein and co-authors.¹⁹

Table 2 shows the summary statistics for overall visual ability, health state and functional domains measured by the AI. Table 3 shows the correlation matrix for the visual and health state variables. All correlations are significantly different from zero ($p < 0.05$). In all cases, the units are dimensionless (logits, utility indices and summed raw scores). The n varies across AI measures because the AI is an adaptive questionnaire and patient's rate only goals and tasks that are identified as important and rate only those tasks that fall under goals that are at least slightly difficult to perform. Across surveys, participant response rate varies, as some subjects did not complete all interviews.

Figure 1 includes a histogram showing the distribution of the EQ-5D scores. The inset shows the linear relationship between z score and EQ-5D utility. This allows for the assumption that we have an approximately normal distribution.

Tables 4 and 5 contain the results of the multivariable regression analyses. Table 4 shows the regression analysis results when all independent variables are included; it specifies the R^2 values for each variable independently. In the regression analyses, the GDS alone accounted for 25% of the observed variance and the SF-36 accounted for nearly 30% of the observed variance in the EQ-5D utility index. Together GDS and SF-36 accounted for 40% of the

variance (based on R^2). Age was also a significant predictor, but accounted for <1% of the variance. Sex, living alone, symptomatic comorbidities, LogMAR visual acuity and each of the AI functional categories were not significant factors in predicting EQ-5D utility. Table 5 shows the second regression model, including only the statistically significant predictors from Table 4. The overall R^2 for significant variables (Table 5) is 0.411.

Discussion

This study sought to investigate the source of variance in a US low vision patient population prior to LVR. This variance limits the use of the EQ-5D as an outcome measure. This analysis shows that the effects of comorbidities (specifically physical health and emotional health as measured by the SF-36 and GDS respectively) contribute most significantly to the patient's responses, and age to a lesser extent. However, the vision variables contribute little to explaining the variance in individual responses to the EQ-5D at baseline. The limited sensitivity of the EQ-5D to visual ability variables precludes using the EQ-5D to measure changes in visual ability targeted by LVR.

The lack of vision contributions to EQ-5D responses is manifested by the lack of predictive value in the regression analysis of visual acuity, the primary visual impairment measure. This is consistent with past studies in which the EQ-5D was effective at differentiating between those with and without an ocular condition, but not between severity levels in various ocular conditions including AMD¹⁴ and glaucoma.¹⁶ The low vision patient population is primarily a geriatric population that is largely affected by comorbid conditions, with multiple prior studies showing elevated levels of depression in this subgroup of patients.^{19,30} However, age contributed little to the variance in the scores in this population, just as age was not a significant predictor of utility values in a glaucoma population.¹⁶ Even in diabetic macular edema,¹⁷ the EQ-5D was not sensitive to the vision impairment. The majority of the between-person variance in the EQ-5D is explained by the physical functioning and depression variables as well as age, as is likely the case across the many other vision-specific quality of life studies that have been performed.^{14,16,17}

The low vision patient population has been characterized in terms of the impact of a specific eye disease on vision-related quality of life. However, there has been limited ability to differentiate degrees of severity of the disease and the impact on health-related quality of life measures. This provides additional limitations in measuring the effect of vision rehabilitation and its ability to change a person's quality of life. The ability to garner this information from clinical studies is valuable in comparing the effectiveness of an intervention in one health discipline to that in another. It also factors in to the determination of the relative cost-effectiveness of interventions.

In this study, we observed that the R^2 was higher in the model with fewer variables. In a truly linear model, we would expect that R^2 would be higher in the model with more variables. The fact that R^2 decreases suggests that the linear approximation is failing. In addition to adding a first order explanatory term with the addition of another independent variable, additional variance is being added by the unexplained higher-order terms associated with that variable.

Although the EQ-5D is a simple psychometric instrument that is easy to use as an outcome measure, it is measuring variables that are not the target of LVR and thus it is not an appropriate tool for evaluating low vision intervention, just as it has been found to be a poor measure for evaluating disease severity in other visual conditions such as AMD¹⁴ and glaucoma.¹⁶

This study is unique in that it specifically addressed the limited role of utility values in a vision rehabilitation intervention. In addition, the study measured utilities across patients with vision impairment from multiple ocular disorders including diabetic retinopathy, macular degeneration and glaucoma rather than including disease-specific analyses. The sample size may limit the ability to generalize conclusions, although the results are consistent with past studies looking at traits of similar populations.

Although policy organizations continue to encourage the use of generic health preference measures, past research has stated that these measures are not sensitive to changes related to eye disease severity. LVR should be viewed differently than other types of intervention because it is specifically targeting quality of life and improvements in visual ability. In LVR, we are rarely able to improve a patient's visual acuity or other vision impairment variables (such as contrast sensitivity). Patients presenting for LVR are taught different ways to accomplish tasks, whether that be incorporating the use of a magnifier, switching to large print, or using audio books to achieve the goal of reading for pleasure. An adaptive tool like the AI examines each rehabilitation goal and task and is able to filter out the goals that are not relevant to a patient. The challenge is to assign health utility values to changes in overall visual ability scores that occur after LVR. Meeting this challenge would provide a more relevant and responsive outcome measure that could be translated directly to gains in quality of life.

Health care reform has increased demand for including quality of life measures in research studies and clinical practice. Quality of life improvements gained from medical intervention should be measured in a common language so that comparisons can be made across health disciplines. However, outcome measures must be clinically meaningful and responsive to the effects of a given intervention. These should also be relevant to health economics outcomes and cross-disease comparisons.¹⁴ Future research in outcome measures should focus on mapping patient-reported outcomes (in responsive measures) to utilities to allow for the necessary cross-discipline comparisons that are required for cost-effectiveness studies.

Funding

This study was supported by EY012045 and EY018696 from the National Eye Institute, National Institutes of Health and a grant from The Reader's Digest Partners for Sight Foundation. The authors have no financial relationship with the sponsors. The study results were not contingent on the sponsor's approval or censorship of the manuscript.

References

1. Massof RW. A model of prevalence and incidence of low vision and blindness among adults in the US. *Optom Vis Sci* 2002;79:31–38. [PubMed: 11828896]

2. Congdon N, O'Colmain B, Klaver CC, et al. Causes and prevalence of visual impairment among adults in the United States. *Arch Ophthalmol* 2004;22:477–485.
3. Brown MM, Brown GC, Sharma S, et al. Quality of life associated with visual loss. *Ophthalmology* 2003;110:1076–1081. [PubMed: 12799229]
4. Javitt JC, Zhou Z, Willke RJ. Association between vision loss and higher medical care costs in Medicare beneficiaries. *Ophthalmology* 2007;114:238–245e1. [PubMed: 17270673]
5. Brown JC, Goldstein JE, Chan TL, et al. for the Low Vision Research Network Study Group. Characterizing functional complaints in patients seeking outpatient low-vision services in the United States. *Ophthalmology* 2014;121:1655–1662. [PubMed: 24768243]
6. Stelmack JA, Tang XC, Reda DJ, et al. Outcomes of the Veterans Affairs Low Vision Intervention Trial (LOVIT). *Arch Ophthalmol* 2008;126:608–617. [PubMed: 18474769]
7. Binns AM, Bunce C, Dickinson C, et al. How effective is low vision service provision? A systematic review. *Surv Ophthalmol* 2012;57:34–65. [PubMed: 22018676]
8. Goldstein JE, Jackson ML, Fox SM, et al., for the Low Vision Research Network Study Group. Clinically meaningful rehabilitation outcomes of low vision patients served by outpatient clinical centers. *JAMA Ophthalmol* 2015;133:762–769. [PubMed: 25856370]
9. FDA. Accessed 21 October 2014 from: <http://www.fda.gov/downloads/Drugs/Guidances/UCM193282.pdf>
10. Weinstein MC, Siegel JE, Gold MR, et al. Recommendations of the Panel on Cost-effectiveness in Health and Medicine. *JAMA* 1996;276:1253–1258. [PubMed: 8849754]
11. Miller W, Robinson LA, Lawrence RS, Institute of Medicine (U.S.). Committee to Evaluate Measures of Health Benefits for Environmental Health and Safety Regulation Valuing health for regulatory cost-effectiveness analysis. Washington, DC: National Academies Press, 2006.
12. Devlin NJ, Parkin D, Browne J. Patient-reported outcome measures in the NHS: new methods for analysing and reporting EQ-5D data. *Health Econ* 2010;19:886–905. [PubMed: 20623685]
13. The EuroQol Group. EuroQolVa new facility for the measurement of health-related quality of life. *Health Policy* 1990;16:199–208. [PubMed: 10109801]
14. Tosh J, Brazier J, Evans P, et al. A review of generic preference-based measures of health-related quality of life in visual disorders. *Value Health* 2012;15:118–127. [PubMed: 22264979]
15. Malkin AG, Goldstein JE, Perlmutter MS, et al., for the Low Vision Research Network Study Group. Responsiveness of the EQ-5D to the effects of low vision rehabilitation. *Optom Vis Sci* 2013; 90:799–805. [PubMed: 23851303]
16. Bozzani FM, Alavi Y, Jofre-Bonet M, et al. A comparison of the sensitivity of EQ-5D, SF-6D and TTO utility values to changes in vision and perceived visual function in patients with primary open-angle glaucoma. *BMC Ophthalmology* 2012;12:43. [PubMed: 22909264]
17. Fenwick EK, Xie J, Ratcliffe J, et al. The impact of diabetic retinopathy and diabetic macular edema on health-related quality of life in type 1 and type 2 diabetes. *Invest Ophthalmol Vis Sci* 2012; 53:677–684. [PubMed: 22205611]
18. Alavi Y, Jofre-Bonet M, Bunce C, et al. Developing an algorithm to convert routine measures of vision into utility values for glaucoma. *Ophthalmic Epidemiol* 2011;18:233–243. [PubMed: 21961513]
19. Goldstein JE, Massof RW, Deremeik JT, et al. Baseline traits of low vision patients served by private outpatient clinical centers in the United States. *Arch Ophthalmol* 2012;130:1028–1037. [PubMed: 22893074]
20. Chan TL, Goldstein JE, Massof RW; Low Vision Research Network Study Group. Comparison of clinician-predicted to measured low vision outcomes. *Optom Vis Sci* 2013;90:776–787. [PubMed: 23873036]
21. Goldstein JE, Chun MW, Fletcher DC, et al., Low Vision Research Network Study Group. Visual ability of patients seeking outpatient low vision services in the United States. *JAMA Ophthalmol* 2014;132: 1169–1177. [PubMed: 25073745]
22. Massof RW, Ahmadian L, Grover LL, et al. The Activity Inventory: an adaptive visual function questionnaire. *Optom Vis Sci* 2007;84:763–774. [PubMed: 17700339]
23. Manly JJ, Schupf N, Stern Y, et al. Telephone based identification of mild cognitive impairment and dementia in a multicultural cohort. *Arch Neurol* 2011;68:607–614. [PubMed: 21555635]

24. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992;30:473–483. [PubMed: 1593914]
25. Lyness JM, Noel TK, Cox C, et al. Screening for depression in elderly primary care patients: a comparison of the Center for Epidemiologic Studies-Depression Scale and the Geriatric Depression Scale. *Arch Intern Med* 1997;157:449–454. [PubMed: 9046897]
26. Andrich D A rating formulation for ordered response categories. *Psychometrika* 1978;43:561–573.
27. Linacre JM, Wright BD. A user's guide to Winsteps Rasch-Model Computer Program. Chicago, IL: MESA Press, 2001.
28. Zelinski EM, Gilewski MJ. Effects of demographic and health variables on Rasch scaled cognitive scores. *J Aging Health* 2003;15:435–464. [PubMed: 12914012]
29. Shaw JW, Johnson JA, Coons SJ. US valuation of the EQ-5D health states: development and testing of the D1 valuation model. *Med Care* 2005;43:203–220. [PubMed: 15725977]
30. Rovner BW, Casten RJ, Massof RW, et al. Psychological and cognitive determinants of vision function in age-related macular degeneration. *Arch Ophthalmol* 2011;129:885–890. [PubMed: 21746979]

Figure 1. Distribution of EuroQol 5-dimension questionnaire (EQ-5D) scores including inset showing linearity of z-scores to EQ-5D utility index, in a low vision sample ($N= 779$), USA.

Table 1.Characteristics of patients (N = 779) in a low vision sample, USA.¹⁵

Age range, years	19–98
Median age, years	77
Older than 65 years, % (<i>n</i>)	75 (584)
Female, % (<i>n</i>)	66 (514)
Profound impairment (20/500 or worse), % (<i>n</i>)	6 (47)
Severe impairment (20/200–20/500), % (<i>n</i>)	19 (148)
Moderate impairment (20/70–20/200), % (<i>n</i>)	38 (296)
Mild impairment (better than 20/70), % (<i>n</i>)	37 (288)

Table 2.

Estimated visual ability measure and health state measure in a low vision sample ($n = 779$), USA.

Questionnaire	<i>n</i>	Mean (SD)
AI measure (logits)		
Reading	739	0.803 (1.366)
Mobility	574	0.519 (1.120)
Visual information	700	0.709 (1.092)
Visual motor	728	0.768 (1.102)
Overall visual ability/goals	779	0.976 (1.270)
EQ-5D (utility index)	766	0.790 (0.185)
SF-36 (logits)	758	0.573 (2.413)
GDS (logits)	700	−2.087 (1.744)
TICS (summed raw scores)	741	38.601 (5.864)

In all cases, the units are dimensionless (logits, utility indices, and summed raw scores). AI, Activity Inventory; EQ-5D, EuroQol 5-dimension questionnaire; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey physical functioning component; GDS, Geriatric Depression Scale; TICS, Telephone Interview for Cognitive Status; SD, standard deviation.

Table 3.

Pearson correlation matrix for visual and health state variables in a low vision sample ($N = 779$), USA.

Questionnaire	AI reading	AI mobility	AI visual information	AI visual motor	AI goals	GDS	SF-36 physical	TICS	EQ-5D	LogMAR
AI reading	1									
AI mobility	0.476	1								
AI visual information	0.687	0.585	1							
AI visual motor	0.747	0.619	0.765	1						
AI goals	0.751	0.596	0.724	0.812	1					
GDS	-0.215	-0.304	-0.237	-0.322	-0.394	1				
SF-36 physical	0.185	0.371	0.220	0.354	0.359	-0.425	1			
TICS	0.189	0.261	0.151	0.226	0.151	-0.210	0.295	1		
EQ-5D	0.206	0.322	0.241	0.329	0.405	-0.502	0.545	0.169	1	
LogMAR	-0.471	-0.264	-0.347	-0.317	-0.375	0.072	-0.094	-0.156	-0.150	1

AI, Activity Inventory; GDS, Geriatric Depression Scale; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey physical functioning component; TICS, Telephone Interview for Cognitive Status; EQ-5D, EuroQol 5-dimension questionnaire; LogMAR, logarithm of the minimum angle of resolution.

Table 4.

Multivariable regression model coefficients for all independent visual and health state variables in a low vision sample ($N = 779$), USA (overall $R^2 = 0.356$).

Questionnaire	Coefficient	Standard error	Standard coefficient	<i>p</i> -value	R^2
AI reading	−0.004	0.011	−0.031	0.687	0.042
AI mobility	0.001	0.009	0.006	0.914	0.104
AI visual information	−0.003	0.014	−0.016	0.830	0.058
AI visual motor	0.007	0.016	0.040	0.641	0.108
AI visual ability/goals	0.02	0.017	0.105	0.237	0.164
GDS ^a	−0.022	0.005	−0.215	<0.001	0.252
SF-36 physical ^a	0.036	0.004	0.482	<0.001	0.297
TICS	−0.001	0.001	−0.026	0.575	0.029
LogMAR	0.028	0.02	0.069	0.16	0.023
Age ^a	0.002	0.001	0.157	0.002	0.002
Comorbidities	−0.001	0.005	−0.008	0.855	
Sex	0.009	0.017	0.022	0.606	
Live alone	0.028	0.017	0.075	0.096	
Constant	0.585	0.076		<0.001	

^aVariables with regression coefficients significantly different from zero. Visual acuity was a continuous LogMAR variable. For the categorical variable, 1 = male.

AI, Activity Inventory; GDS, Geriatric Depression Scale; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey physical functioning component; TICS, Telephone Interview for Cognitive Status; LogMAR, logarithm of the minimum angle of resolution.

Table 5.

Multivariable regression model coefficients for significant predictors of the health utility index estimated from EQ-5D responses in a low vision sample ($N=779$), USA (overall $R^2=0.411$).

Questionnaire	Coefficient	Standard error	Standard coefficient	<i>t</i> -value	<i>p</i> -value
Age	0.002	<0.001	0.152	4.227	<0.001
GDS	-0.027	0.004	-0.255	-6.866	<0.001
SF-36 Physical	0.038	0.003	0.514	13.173	<0.001
Constant	0.635	0.056		11.429	<0.001

GDS, Geriatric Depression Scale; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey physical functioning component.