

Evaluation of Quality of Life and Priorities of Patients with Glaucoma

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PURPOSE. To investigate the quality of life and priorities of patients with glaucoma.

METHODS. Patients diagnosed with glaucoma and no other ocular comorbidity were consecutively recruited. Clinical information was collected. Participants were asked to complete three questionnaires: EuroQol (EQ-5D), time tradeoff (TTO), and choice-based conjoint analysis. The latter used five-attribute outcomes: (1) reading and seeing detail, (2) peripheral vision, (3) darkness and glare, (4) household chores, and (5) outdoor mobility. Visual field loss was estimated by using binocular integrated visual fields (IVFs).

RESULTS. Of 84 patients invited to participate, 72 were enrolled in the study. The conjoint utilities showed that the two main priorities were "reading and seeing detail" and "outdoor mobility." This rank order was stable across all segmentations of the data by demographic or visual state. However, the relative emphasis of these priorities changed with increasing visual field loss, with concerns for central vision increasing, whereas those for outdoor mobility decreased. Two subgroups of patients with differing priorities on the two main attributes were identified. Only 17% of patients (those with poorer visual acuity) were prepared to consider TTO. A principal component analysis revealed relatively independent components (i.e., low correlations) between the three different methodologies for assessing quality of life.

CONCLUSIONS. Assessments of quality of life using different methodologies have been shown to produce different outcomes with low intercorrelations between them. Only a minority of patients were prepared to trade time for a return to normal vision. Conjoint analysis showed two subgroups with different priorities. Severity of glaucoma influenced the relative importance of priorities. (*Invest Ophthalmol Vis Sci.* 2008;49:1907-1915) DOI:10.1167/iovs.07-0559

Maximization of a patient's quality of life (QoL) is one of the main goals of any clinical intervention.¹ During the past 10 years, QoL has been investigated in the context of many different ophthalmic conditions.²⁻⁸ Several studies have examined glaucoma specifically. These indicate (perhaps not

surprisingly) that (1) QoL is reduced if people have glaucoma at all,^{9,10} and (2) that among people with glaucoma, QoL decreases with the severity of field loss.¹¹⁻¹⁴

Although most conventional QoL measures are useful in identifying the presence, absence, severity or frequency of symptoms, impairments, and disabilities, they do not assess the relative importance or priority of different symptoms and disabilities that may give a better idea of when to intervene.^{1,15} The practical consequences of vision loss to a person's QoL are influenced by the priority or relative importance given to different tasks which the person finds difficult to perform. This is a key issue, both in the allocation of limited resources and in rehabilitation strategies for patients.¹⁵⁻¹⁷ One way of looking at relative importance in QoL research is to measure the "utility" of different levels of a condition. The measurement of a utility in the healthcare domain allows an "objective measurement of the desirability of a health (disease) state."¹⁷ Utilities are usually measured on a scale of 0.0 to 1.0, where 0.0 is equivalent to death, and 1.0 is equivalent to perfect health. However, in ophthalmology it is common to refer to vision-related QoL using scale items that differ between scales (e.g., functional task questions to those involving emotional concerns) and in which the end points of the scale are quite different. For example most utility studies examining vision are performed on a scale bounded by perfect vision rather than by perfect health. Two important consequences are first that the meaning of utility is not that conventionally used and second that calculated utilities are not comparable across scales for purposes such as estimating the cost effectiveness of treatments for glaucoma.

Studies about the value or utility of healthcare interventions can use other different methodologies, such as standard gamble, time tradeoff (TTO) or discrete choice methods. All these methods are characterized by patients making a choice between alternative situations from which relative importance or value can be derived. The standard gamble approach has some limitations mainly because of difficulties some people experience in making use of probabilistic evidence,¹⁸ although in selected circumstances it can be used successfully in aiding clinical decisions about alternative choices for individual patient management.¹⁹

Utility measurements (or measurements of relative value or worth) have been performed in a few studies in ophthalmology.²⁰⁻²⁷ For example, in the field of cataract surgery, Bass et al.²⁰ found that utilities of preoperative vision (assessed using a rating scale) were more closely related to subjective ratings of QoL than to objective measures of visual acuity. In patients with age-related macular degeneration (AMD) and diabetic retinopathy, utilities were highly dependent on the degree of visual loss in the better eye.^{17,21} More specifically, in a study of how patients with glaucoma rate various degrees of vision loss, Jampel²² showed that utility values do not correlate well with Esterman binocular visual fields and he concluded that, "a challenge for the future will be designing clinical tests that better correlate with patient perceptions."

The use of choice-based conjoint analysis to investigate relative importance has been used only recently in ophthalmol-

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Supported by an EPSRC grant and by Allergan Europe.

Submitted for publication May 11, 2007; revised October 6, 2007, and January 3, 2008; accepted March 5, 2008.

Disclosure: P.A. Aspinall, Allergan Europe (F); Z.K. Johnson, None; A. Azuara-Blanco, None; A. Montarzano, None; R. Brice, None; A. Vickers, None

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ogy,^{23,27} but had been applied previously in diverse healthcare contexts.²⁸⁻³¹ The possibility that there may be sudden declines in QoL when certain thresholds of field loss are reached has been suggested by Parrish et al.,¹¹ but has not been investigated in this context (i.e., with more severely affected patients, or with a QoL instrument that identifies the relative importance rather than the presence of disability). Results of a study of perceived and actual performance of daily tasks in patients with retinitis pigmentosa have suggested that there may be such thresholds.⁵² That study also showed that moderate or worse difficulty in performance occurred only with visual acuity worse than 20/40, log contrast less than 1.4, and a visual field smaller than an area equivalent to 50° (Goldmann II-4e target).

In 2005, our group published a pilot study of QoL in glaucoma, in which we used choice-based conjoint analysis.²⁷ The purpose of this article is to present new evidence from an independent study in which a variation of the original conjoint analysis method was used, and the utility questionnaires TTO and EuroQoL (EQ-5D) were included to evaluate intercorrelations between these different measures of relative importance. The main emphasis will be on the conjoint results, as they are most novel to the field, with other scales providing a context to the conjoint findings. Although it has been pointed out that these scales measure different aspects of QoL it is important to know first what degree of common ground is shared between them. Another goal of the study was to explore the relationship between the different QoL scales and clinical and functional data.

METHODS

This study adhered to the tenets of the Declaration of Helsinki and was approved by the local research ethics committee. Patients with glaucoma were consecutively recruited from the glaucoma clinics at the Department of Ophthalmology of the Aberdeen Royal Infirmary from May through September 2006. Patients with diagnosed glaucoma and reliable visual field test results within 6 months of the interview were included. Reliable visual field test results were defined as those with less than 25% fixation errors, 25% false negatives, and 15% false positives. Patients with other ocular morbidity, such as dense cataract and age-related macular degeneration, were excluded, as were those unable to understand or complete the questionnaire. Information about the nature of the study and instructions for completing the questionnaire were given by the same investigator (ZJ).

The following clinical variables were obtained from the medical notes: time since diagnosis of glaucoma, type of glaucoma, number of glaucoma medications, history of previous surgery and other ocular morbidity, best corrected visual acuity (Snellen), and visual field test results (SITA 24-2 program of the Humphrey perimeter; Carl Zeiss Meditec, Oberkochen, Germany). Binocular integrated visual fields (IVFs) were used to measure visual function.³³⁻³⁵ Crabb et al.³³ have described a novel method of estimating a patient's binocular field of view from their monocular measurements.³³ Computer software merges individual sensitivity values from the left and right visual fields to generate a map of the central binocular visual field, known as the integrated visual field. Mild visual field loss was defined as no defect in the central 20° of the binocular visual field. Moderate field loss was defined as the presence of one to five points with sensitivities of 10 dB or less in the central 20° binocular visual field. Severe visual field loss consisted of six or more points with sensitivities of 10 dB or less in the central 20° binocular visual field. Patients with severe visual loss as just defined would not be able to drive in the United Kingdom according to current regulations (<http://www.dvla.gov.uk/medical>).

Functional QoL Questionnaires

Data were collected by using a general index, EQ-5D, TTO, and choice-based conjoint analysis.

The TTO method has been used successfully to assess health-related QoL utilities.^{10,11,20-22,35,36} Utility scores are a representation of the relative desirability of a particular state of health compared with the reference states of death (utility score, 0) and perfect health (utility score, 1.0). In this study, the scale end points were death (utility score, 0) and perfect vision (utility score, 1). The following two-part question was used to generate the percentage of the remaining years of expected life that a respondent was prepared to trade off for a hypothesized restoration of normal vision:

1. How many additional years do you expect to live? Choose from one of eight estimates: 5, 10, 15, 20, 25, 30, 35, or 40 years.
2. How many of these years would you be prepared to give up if you could receive a new technology that would restore your sight to a normal level?

The TTO variable is the percentage of remaining expected life years (P) that the respondent would trade for a cure. The relationship of this variable to utility is $utility = (100 - P)/100$. A high percentage of years that a person is willing to trade, therefore, represents a low utility associated with a respondent's current state of health.

The EQ-5D is a descriptive instrument that consists of five questions addressing five general health attributes (mobility, self care, usual activities, pain/discomfort, and anxiety/depression) with three levels of answers to describe the overall health state of the individual. Utility measures associated with EQ-5D answers have been estimated in the general population in the United States.^{26,37}

The choice-based conjoint analysis method allows the researcher to present different combinations of health states to a person and ask which is considered to be the more- or less-desirable state.³⁸⁻⁴⁰ The health states (or levels of disability) are defined by a set of attributes associated with a disease and a set of levels or degrees of difficulty associated with each of these attributes. In the present study, the attributes were aspects of (1) central and near vision, (2) outdoor mobility, (3) bumping into things/peripheral vision, (4) household chores, and (5) problems with darkness and glare from bright lights (Table 1). The set of three levels of difficulty associated with these attributes were "none," "a few," and "a lot." These reflect the type of descriptors used almost exclusively in vision-related QoL or functional disability instruments (e.g., the NEI VFQ-25).⁵ The attributes used in this study were selected from our previous work as being relatively independent and representative of daily activity problems.^{13,14} In the present study, the questionnaire involved paired comparisons of daily activity profiles in which the subject considered each pair and decided which would be the least desirable scenario (Table 1).

Details of Conjoint Analysis

General. A comparison of each attribute at each impact level of difficulty involved 243 potential treatment combinations (i.e., 3⁵: three levels of difficulty for each of the five attributes). This set was reduced to a manageable number, by deriving an orthogonal fraction of the full factorial design that preserved first-order interactions, resulting in 15 paired comparisons.²⁷ Patients were all given "practice" using different comparisons before the data were collected. The five-attribute paired comparisons were presented visually, with the profiles side by side in 36-point print size, and relied on simultaneous comparison.

The conjoint analysis data were recorded and analyzed by multinomial logit (MNL) analysis providing (1) the relative importance of each attribute for the aggregate total sample level and for each respondent and (2) the scores for each attribute-by-level combination for the aggregate total sample and for each respondent. The conjoint analysis data were recorded and analyzed using MNL analysis software (Sawtooth Software, Sequim, WA).⁴¹

The hierarchical Bayesian module was run on the conjoint data to produce individual priorities for each person in the study. Latent class analysis was then applied to the individual priorities, to identify separate clusters or subgroups of people.

TABLE 1. Vision-Related Attributes Evaluated in the Conjoint Analysis and an Example of a Comparison of Two Patients' Responses

Factors	Attributes
1. Central and near vision 2. Darkness and glare 3. Outdoor mobility 4. Household chores 5. Peripheral vision	Problems with reading or seeing detail Problems with darkness or glare from bright lights Problems getting out and about outside Problems with cooking, cleaning or with self care Problems bumping into things, or tripping over objects
Person 1 had . . .	Person 2 had . . .
<ul style="list-style-type: none"> ● A lot of problems bumping into and seeing objects at the side. ● A few problems getting about outside the house. ● No problems doing household chores. ● A few problems with darkness or glare. ● A few problems with reading or seeing details. 	<ul style="list-style-type: none"> ● No problems bumping into and seeing objects at the side. ● A lot of problems getting about outside the house. ● A few problems doing household chores. ● No problems with darkness or glare. ● No problems with reading or seeing detail.

The patients were asked to put themselves in the shoes of both persons and to state which person, in their opinion, was the worse off.

To examine the inter-relationship between the QoL scales, principal component (PCA) and multidimensional preference analyses were performed.

Sample Size Calculation. With conjoint methods, nothing is known about the standard errors of the statistics being estimated. There is no sampling theory to use, and the only information available would be from previous studies, if these existed. The sample size (n) should be greater than $(500c)/(ta)$, where t is the number of tasks, a is the number of choices per task, and c is the maximum number of levels for any one attribute for a main-effects model or the largest product of the levels of any two attributes for all first-order interactions. For a five-attribute, three-level, two-choice model, this means a sample size of 50 for a main-effects model and of 150 for a model containing all first-order interactions.⁴² In the present study we were interested only in main effects and two first-order interactions (bumping into things, as a consequence of visual field loss, and its impact in outdoor mobility; and darkness and glare, the most commonly reported concern, and their effects on outdoor mobility), for which 70 patients would suffice.

Analysis of the Direct-Choice Questionnaire Data. An MNL conditional model with dummy variables (based on MNL and McFadden's choice models^{43,44}) was specified, with the choice responses as the binary dependant variable and the differences in levels for each attribute within each choice as the independent variables. For each respondent, the function to be estimated was of the following form:

$$P_k = \exp(\mathbf{x}'_k \boldsymbol{\beta}_1) / \sum_i \exp(\mathbf{x}_i \boldsymbol{\beta}_1),$$

where P_k is the probability of an individual choosing the k th scenario in a particular choice task; \mathbf{x}_j is a vector of values describing the j th alternative in that choice task; and $\boldsymbol{\beta}_1$ is a vector of utility coefficients for the i th respondent.

These utility coefficients are assumed to have the multivariate normal distribution

$$\boldsymbol{\beta}_1 \sim \text{normal}(\boldsymbol{\alpha}, D),$$

where $\boldsymbol{\alpha}$ is a vector of means of the distribution of individuals' utility values and D is a matrix of variances and covariances of the distribution of utility values across individuals.

The data were analyzed according to equation 2, in the CBC/HB analysis module.⁴⁵ This module uses an iterative Monte Carlo Markov chain procedure with a Metropolis-Hastings algorithm.^{46,47} This approach has been shown to be particularly beneficial when the small fractional designs are used and/or the data are heterogeneous.^{48,49}

The output from this analysis was a set of 15 utility coefficients (one for each of the three levels within each of the five attributes) for each respondent.

Calculating the Relative Importance of Variation within Attributes. The relative importance (RI) of variation across the range of each of nine attributes was calculated by using the utility values resulting from the CBC/HB analysis. This calculation was made for each respondent⁵⁰:

$$RI_{ij}(\%) = 100 \times (U_{ij\max} - U_{ij\min}) / \sum (U_{ij\max} - U_{ij\min}),$$

where $U_{ij\max}$ is the maximum utility value of levels within the i th attribute and $U_{ij\min}$ is the minimum utility value of levels within the i th attribute for the j th respondent.

The overall relative importance of attributes was calculated at both the individual and aggregate sample levels (Fig. 1). The RI of an attribute at the individual level is defined as $\sum RI_{ij}/n$ (i.e., the mean of the importance of each attribute for each respondent).

The aggregate level relative importance was calculated by applying the importance formula to the means of the utility values across the whole sample (i.e., treating the means for utility values across all individuals as though they were from one individual). An example of the mean utility values used for one attribute is shown in Figure 2.

A difference between attribute importance, as measured by these two methods, is an indication of the extent of heterogeneity within the respondent sample and the attributes where this occurs.

RESULTS

A total of 84 patients were invited to participate. Completed questionnaires were returned by 72 patients. Reasons for declining the invitation to participate included too ill or poor general health ($n = 1$), looking after an ill relative ($n = 1$), moved away ($n = 1$), or too busy ($n = 1$); some failed to return the questionnaires after initially having agreed to participate ($n = 7$). A summary of patient data is given in Table 2. Five patients had visual acuity worse than 6/12. Four of these five patients had a visual acuity of 6/18 in the better eye. One patient had visual acuity of 6/36 in the better eye, and was due to end-stage glaucoma (in both eyes).

Results from Conjoint Analysis

QoL: Perceived Importance. The relative importance of each attribute at each level was calculated and is shown in Figure 1. The ordinate lists the five attributes, and the abscissa is the measure of relative importance or utility on a percentage scale.

The two main priorities of the participants were clearly central vision (reading or seeing detail) and outdoor mobility (getting about outside the house), which, as can be seen from the confidence limits, were significantly different from each

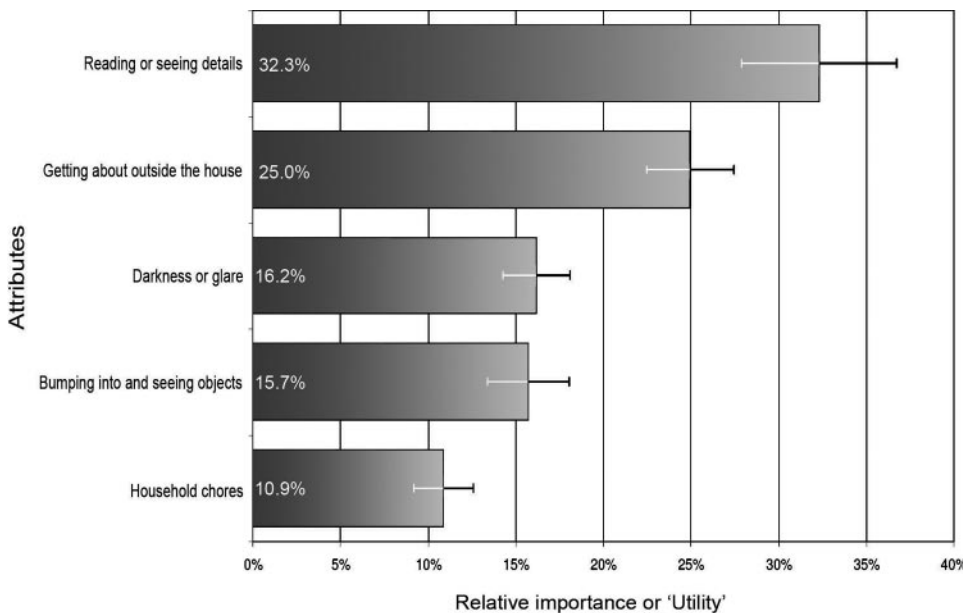


FIGURE 1. Relative importance across the five attributes measured.

other and accounted for more than half the share of relative importance. There is then a gap in the rankings of the third and fourth attributes, which are not significantly different from each other but are significantly different from higher-order attributes and from the lowest ranked attribute of household chores.

In addition, the difference between the relative importance scores for problem levels of an attribute is a measure of the impact on QoL from changes in those levels. So, for example, in the case of central vision, shown in Figure 2, the difference between “no problems” and “a few problems” (i.e., 1.5 units) is less than the difference between “a few problems” and “a lot of problems” (i.e., 3.7 units). A *t*-test of this difference is significant at $P = 0.01$, hence the perceived change between a few and a lot of problems is more significant to people than that between no problems and a few problems. This relationship of greater perceived importance for the change between a few and a lot of problems is similar in the other attributes evaluated in this study.

Subgroups of Respondents. Multidimensional preference analysis is PCA in reverse. In Figure 3, the attribute impor-

tances are locations in space and respondent preferences are arrows into space from the center of the graph. The density of the shading on the graph shows the direction where most arrows (i.e., people’s preferences) are located. The figure shows that reading or seeing detail and getting about outside the house are the two most important attributes. There is evidence of two clusters in the data, with most respondents giving the most importance to reading and seeing detail and a smaller segment giving greater importance to getting about outside the house. The horizontal axis is the first principal component in the analysis accounting for 51% of variance (to which reading is mainly linked), and the second principal component is the vertical axis accounting for 29% of variance (to which getting about outside the house is mainly linked). Hence, a two-component solution accounts for 80% of variance.

Results from TTO

Table 3 summarizes the TTO results and shows only that only 17% of the study group of persons with glaucoma were pre-

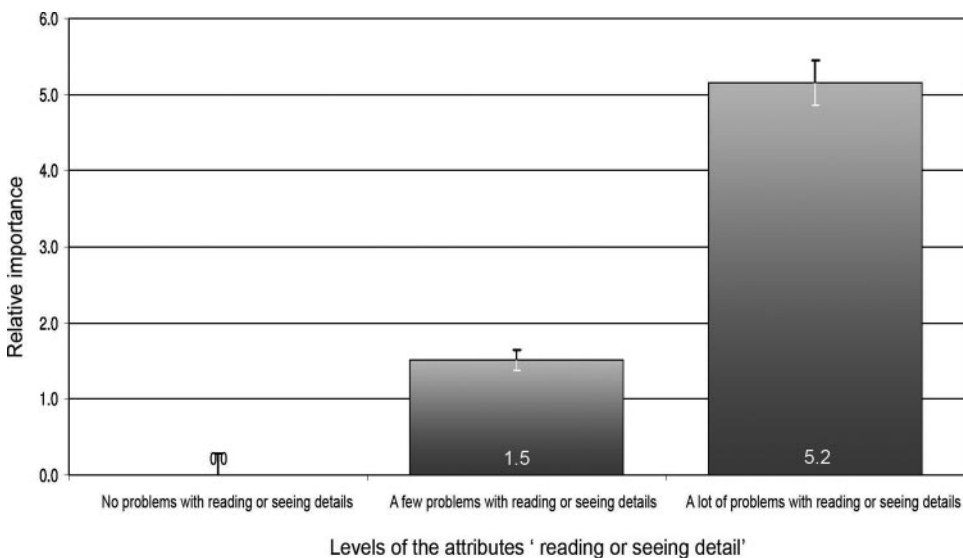


FIGURE 2. Differences of relative importance (y-axis) between attribute levels: “no problems,” “a few problems,” and “a lot of problems.”

TABLE 2. Demographic and Clinical Information for 72 Patients

Mean age, y (SD)	71.8 ± 11.0
Time since glaucoma first diagnosed (median), y	8
Sex	
Male	n = 38 (53%)
Diagnosis categories (number of patients)	
POAG	n = 49 (68%)
NTG	n = 11 (15%)
ACG	n = 8 (11%)
PXF	n = 4 (6%)
Snellen best corrected visual acuity	
6/12 or better in both eyes	n = 56 (78%)
6/12 or better in one eye, <6/12 in other eye	n = 11 (15%)
Worse than 6/12 in both eyes	n = 5 (7%)
Binocular VF score	
Mild (no defect in the central 20°)	n = 41 (57%)
Mean MD of worse eye	-8.02
Mean MD of better eye	-2.86
Moderate (1 to 5 points with sensitivities of ≤10 dB in the central 20°)	n = 20 (28%)
Mean MD of worse eye	-14.39
Mean MD of better eye	-5.51
Severe (6 or more points with sensitivities of ≤10 dB or less in the central 20°)	n = 11 (15%)
Mean MD of worse eye	-22.24
Mean MD of better eye	-15.34
Previous glaucoma surgery in either or both eyes	n = 31 (43%)
Topical medication in both eyes	n = 64 (89%)
1 agent	n = 18 (25%)
2 agents	n = 27 (38%)
3 agents	n = 16 (22%)
4 agents	n = 3 (4%)

POAG, primary open-angle glaucoma; NTG, normal-tension glaucoma; ACG, angle-closure glaucoma; PXF, pseudoexfoliation syndrome; VF, visual field.

pared to trade. Given the small numbers involved, the data in the table are simply indicative, but suggest that around half of those trading are for 15% to 30% of remaining time. When a χ^2 test was used to see whether there were any variables that discriminated those who traded from those who did not, the only significant variable that did so was visual acuity, with traders having significantly poorer vision than nontraders ($\chi^2 = 3.8, df = 1, P < 0.05$).

On the assumption that willingness to trade may be linked to the expected number of years remaining, the difference in

TABLE 3. TTO Results

No People Trading	Proportion of Remaining Months Traded	Proportion Trading (%) (n = 12)	
12/71 (17%)	<0.15	n = 12	n = 71
	0.15-0.30	25	4
	0.31-0.5	42	7
	>0.51	25	4
		8	1

life expectancy between traders and nontraders was tested. Although the mean number of years of the former was less (14 years compared with 17 years), this difference did not reach statistical significance in the small sample involved.

Results from EQ-5D

A summary of the EQ-5D scale is given in Table 4. Results show that a large majority of patients had no problems across all scales, with the exception of pain. The EQ-5D index for utility shows the largest difference between mild and moderate field loss.

The mean value of the EQ-5D index was 0.76 ± 0.19 (SD). In patients with mild visual field loss, the mean EQ-5D index was 0.84 ± 0.17; in moderate visual field loss, 0.68 ± 0.21; and in severe visual field loss, 0.64 ± 0.26.

With respect to other clinical and demographic variables, mobility was linked to age ($r = 0.31, P < 0.01$); years of diagnosis ($r = 0.34, P < 0.01$); visual acuity ($r = 0.25, P < 0.05$); and severity of visual field loss ($r = 0.26, P < 0.05$). Self-care was linked to acuity ($r = 0.34, P < 0.01$); and severity of visual field loss ($r = 0.33, P < 0.05$). Activities and pain were linked to years since diagnosis ($r = 0.26$ and $r = 0.25$, with $P < 0.05$, respectively). Anxiety was linked to visual acuity ($r = 0.27, P < 0.05$). The summed index score was linked to years since diagnosis ($r = 0.26, P < 0.05$), visual field loss ($\chi^2 = 20.1, df = 1, P < 0.01$), and visual acuity ($\chi^2 = 14.3, df = 1, P < 0.01$).

Interactions between Conjoint Results and Clinical and Demographic Variables

A significant effect of visual field loss severity on the relative importance of the conjoint attributes was shown for reading.

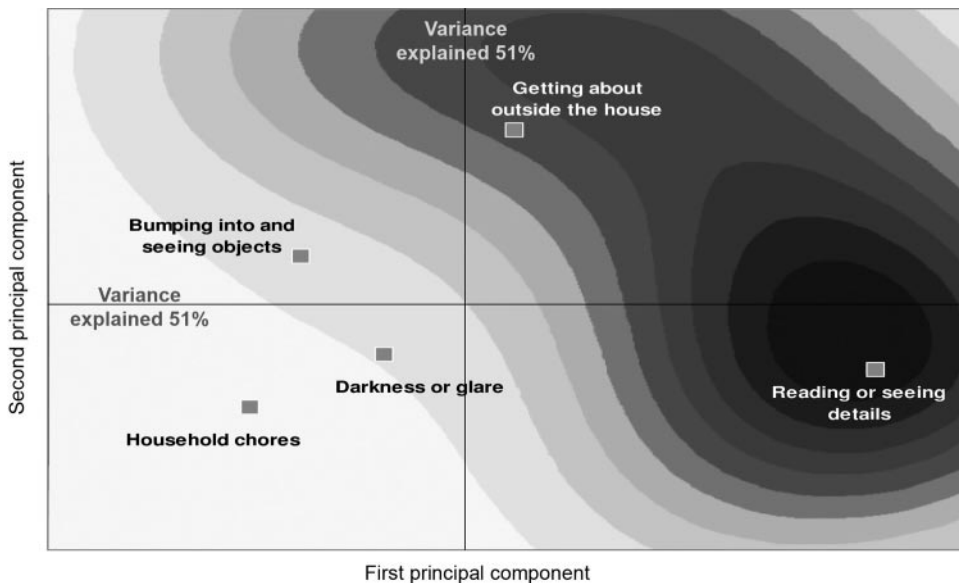


FIGURE 3. Multidimensional preference analysis.

TABLE 4. EQ-5D Results

EQ-5D	Mobility	Self-care	Activities	Pain	Anxiety
Score 1: no problems	72%	87%	65%	55%	80%
Score 2: moderate problems	25%	10%	30%	41%	17%
Score 3: severe problems	0%	0%	3%	3%	0%
Missing	3%	3%	2%	1%	3%

However, there was a further interesting trend that as a measure of binocular field loss increased, the relative importance of central vision also increased, whereas when visual field loss increased, the relative importance of outdoor mobility decreased. Table 5 shows this change in relative importance for central vision, rising from 33% to 39%, whereas importance of outdoor mobility falls from 24% to 19%. This effect was tested by removing the five patients with acuities worse than Snellen 6/12, and it was still found to hold.

Table 5 also shows a similar significant change with decreasing visual acuity. However, in this case while the relative importance for outdoor mobility drops sharply with increasing acuity loss ($P < 0.01$) the importance of central vision becomes slightly increased with increased acuity loss, although not significantly so ($P = 0.08$).

A second influence on the conjoint results was an interaction effect between sex and age. Males of all ages prioritized reading over getting about outside. This was also the case in females older than 75 years. However, the younger females (<75) significantly prioritized getting about over reading ($F = 4.24$, $P = 0.007$).

Interrelations between QoL Measures

A PCA was performed to examine the interrelationship between the QoL scales (i.e., each of the EQ-5D scales: mobility, anxiety, activities, self-care, and pain) and the U.S. weighted index, TTO, and conjoint attributes. The analysis on QoL scales showed five components meeting the conventional eigenvalue criterion of 1 and accounting for 87% of variance in the data. This eigenvalue ensures that a principal component accounts for at least as much variance as that shared equally between the variables. The first component contained the conjoint scales at different levels of difficulty but did not include reading. The second component contained all the EQ-5D scales and showed a very high correlation between them. The third and fourth components were conjoint based and related to different degrees of difficulty with reading, and the fifth component related to outdoor mobility (conjoint) and TTO. The TTO loading (i.e., correlation with the component) was low (0.5) and was based on 12 people prepared to trade. The main conclusion from this analysis was the relative independence of the QoL scales. Although the conjoint attributes were spread across four of the five components, the EQ-5D scales were on one independent component.

TABLE 5. Change in Relative Importance with Field Loss and Acuity

Conjoint Attribute	Visual Field		Visual Acuity	
	Loss Mild	Loss Severe	6/12 or Better	Worse Than 6/12
Central Vision	33%	39%	32%	37%
Outdoor mobility	24%	19%	25%	18%

Significance: visual fields, $t = 3.2$, $P < 0.01$; visual acuity, $t = 2.7$, $P < 0.01$.

Intercorrelations between the QoL measures and the clinical and visual data showed that (1) conjoint individual priorities derived for each patient were not significantly associated with the patients' clinical state, and (2) the EQ-5D scale index related to an individual level of visual field loss.

DISCUSSION

QoL measures are increasingly recognized as important outcomes in understanding the impact of a disease and evaluating the effectiveness of healthcare interventions.²⁻¹⁴ Several investigators have recognized the need to go beyond the conventional QoL questionnaire and to assess other aspects such as utilities and priorities. Measurement of utilities is essential for an economic evaluation of interventions. The available methodologies for assessment of utilities have been used recently in ophthalmology.²⁰⁻²⁷

It is also important to evaluate the relative importance of symptoms or disabilities to better understand the effect of a disease in a patient's QoL. The conjoint methodology is ideally suited for measuring relative importance or priorities, because it invites the respondent to make a relative judgment, or tradeoff, between different options (or, in the present case, profiles of disability) and to make a choice as to which is the better or worse state of health. Because this relative aspect of judgment mirrors most real life situations, the method is seen as realistic, practical, and relatively free of bias.²⁹ Although it is impossible to comment at this stage on the wider issue of validity, the results from other healthcare studies are encouraging.²⁷⁻³² More than 85% of patients with glaucoma found the methodology of the procedure easy to understand, and more than 90% of the group completed the task within 15 minutes.^{13,14,27}

In the clinical management of glaucoma, detailed threshold testing of monocular fields with automated white-on-white perimetry is the standard for establishing the severity of the disease. However, a better method of evaluating visual function in glaucoma would need to evaluate binocular visual fields.³³⁻³⁵ Nelson-Quigg et al.³⁴ examined different ways of "merging" results from monocular visual fields and recommended that the IVF technique is best at representing the central binocular visual field in patients with glaucoma. The IVF has also been shown to be more relevant than the binocular Esterman in measuring patients' self-reported problems with performing daily tasks and general mobility,³⁵ and thus it was used in this group of patients.

In this study, we compared TTO with conjoint analysis and compared the conjoint element with results in a previous study (Table 6) by the authors. First, with respect to the two conjoint studies, the attributes for both studies were those arising from a PCA of a QoL questionnaire in glaucoma developed previously by the authors.^{13,14,27} Given the widespread nature of the original questionnaire, it is reasonable to assume that the five attributes used for prioritization cover the principal aspects of daily living for this group of patients. Results show that although glaucoma is characterized by peripheral vision loss, it is concerns involving central vision that are most important to the patients, even when the peripheral field loss is rated as only

TABLE 6. Summary of Utilities Studies in Two Different Cohorts of Patients Evaluated by Our Group²⁷

	Edinburgh Study, 2005 (<i>n</i> = 109) ²⁷	Aberdeen Study, 2007 (<i>n</i> = 72)
Design	Five attributes and three levels	Same attributes and levels but different sets of comparisons, randomly chosen
Conjoint analysis	Main priority reading followed by outdoor mobility Darkness/glare and bumping into objects (no significant difference) Household chores third most important	Main priority reading followed by outdoor mobility Third priority: darkness/glare and bumping into objects (no significant difference) Household chores fifth most important
Evidence of patient subgroups	Two patient subgroups with separate priorities of reading and getting about outdoors	Two patient subgroups with separate priorities of reading and getting about outdoors
Visual acuity	Restricted to Snellen 6/12 or better and not significantly linked to conjoint or QoL	Not restricted and significantly linked to conjoint, time trade-off, and QoL
Sex	Not significant	Significant link with conjoint utilities but confounded with age for females
Visual field	Unioocular fields were analyzed. No overall link with utilities but greater priority to reading at expense of outdoor mobility as field loss increases	Binocular integrated visual fields were used. No overall link with individual utilities but greater priority to reading at expense of 'outdoor mobility' as field loss increases.
Contrast sensitivity	Significantly linked to conjoint attribute of darkness and glare	Not included
Time trade-off	Not included	Included but less than 20% of patients (i.e., those with poorer acuity) prepared to trade
Questionnaire QoL Scales	No association between VF-14 and conjoint attributes	No association between EQ-5D scales and conjoint attributes. However, EQ-5D index discriminating between individual patient field loss severity

mild. In the two independent studies, central vision and outdoor mobility were the main priorities of patients, and these concerns remained the same across all demographic, clinical, and visual states of participants. Furthermore, the rank order of all the attributes in this study remained the same across all changes in demographic or clinical variables, with the exception of females under 75 years, putting outdoor mobility atop the priority list. What did change with clinical state was the relative emphasis or share of attribute preference. For example, in the present study there were shifts in emphasis in priority for reading and outdoor mobility with different levels of both visual field and visual acuity. In both this study and our recent report²⁷ the relative importance of central vision increased, whereas the relative importance of outdoor mobility decreased as peripheral vision or visual acuity loss became greater. In other words, as peripheral visual field loss increased, the patients' priority rating of outdoor mobility was reduced, whereas that of central vision increased. The attribute "darkness and glare" was the most frequently reported problem in this study and the recent publication by our group,²⁷ but was lower on the list of priorities for the participants.

The consistency of the conjoint findings across two independent studies that include modifications to methodology is encouraging, but we are unaware of other research that might enable us to make further comparisons with these findings. In addition to the stability of priority rankings across both studies was the common finding of two patient subgroups centered on either reading and seeing detail or getting about outdoors. However, three important findings for future conjoint studies which were not expected were, first, the low correlations between conjoint utilities and the two other measures of QoL; second, the subtle rather than clear associations between a patient's clinical or visual state and conjoint utilities; and third, the fact that vision impacts shifts in conjoint utilities only when the visual loss is severe. Low correlations between a patient clinical state and conjoint utilities suggest that, in performing the conjoint task, subjects' judgments are independent of their own clinical conditions (i.e., severity of glaucoma).

The findings of the TTO utilities in the present study are qualified by the small proportion of patients (17%) willing to trade any time for a return to normal vision. It appears that people with glaucoma are prepared to trade time only when

central visual acuity is poor. This result is similar to the one reported by Jampel,²² who noted that only 22% of participants were willing to trade any life for ideal vision.

In the present study, there was no relationship between TTO utilities and the conjoint derived utilities, or the EQ-5D questionnaire scales. Three recent studies have assessed utility measures in glaucoma using TTO, standard gamble, or conventional questionnaire methodologies.²⁴⁻²⁶ In a study of utility values in a group of Singapore Chinese adults with primary open-angle or primary angle-closure glaucoma,²⁴ most patients (i.e., two thirds of the group) were not willing to trade time for a return to perfect vision. However, those with worse visual fields in the better-seeing eye were more willing to trade time, whereas those who had no history of a previous trabeculectomy were more willing to risk blindness. In a study among Indian patients with glaucoma,²⁵ utility values were associated with the degree of visual acuity loss but not with the duration of disease, number of medications, or degree of visual field loss. Finally, in a Swedish study,²⁵ utility was assessed by means of a general questionnaire (EQ-5D) containing questions on satisfaction and degree of difficulty with vision. Multiple regression analysis showed that utility measures were significantly linked to visual acuity and to the extent of visual field in the better eye.

The results of this study show that the concerns of a group of patients with glaucoma are primarily associated with an increased awareness of the vulnerability of central vision as the disease progresses and not with the consequences of visual field loss that characterizes the disease. These findings have practical implications, both for the clinical management of glaucoma and the low-vision rehabilitation management of patients with resultant vision loss from the disease. From the point of view of low-vision rehabilitation, the present findings emphasize the importance of not relying on a patient's stated preferences in isolation of other aspects of vision-related QoL. For example, whereas the most frequently reported problems with vision from the QoL questionnaire were related to lighting and glare, this factor was assessed as less important when judged within the context of several other vision-related factors. The other factors, therefore, act to calibrate the importance of a single factor. The finding that patients are concerned about the vulnerability of central vision rather than the char-

acteristic features of visual field loss also suggests that counseling patients may have a relevant beneficial role.

It may be important to highlight that patients with "mild" visual field loss as defined in this study (i.e., no locations within the central 20° of the IVF with substantial sensitivity loss) could have had severe glaucoma in one eye. In this subgroup of patients with mild disease, the average mean deviation loss in the worse eye was -8.02 dB, suggesting in fact that the disease was relatively advanced in one eye.

In conclusion, assessments of QoL using different methodologies have been shown to produce different outcomes with low intercorrelations between them. Results from conjoint analysis are consistent with those in a previous study but not with TTO, which showed only 17% of patients prepared to trade years of life for restored vision, nor with the use of EQ-5D scales, in which PCA showed the scales and the conjoint utilities to occupy different components. Analysis of patient utilities showed two subgroups with different priorities.

Acknowledgments

The authors thank Ananth C. Viswanathan for providing the software to analyze integrated visual fields; Jennifer Burr for reviewing the manuscript; and Patricia Buchholz (Allergan Europe) and Carolyn Steeds (CS Consulting Scotland) for enabling necessary support for the study.

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