Questionnaires for measuring cataract surgery outcomes

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Patient-reported outcome is an important part of the evaluation of a surgical procedure. Numerous questionnaires for patient's self-assessed activity limitation because of cataract have been published. The technique for constructing and evaluating questionnaires has changed over time. This review evaluates the psychometric properties of patient questionnaires that have been published since 1992. The evaluation includes questionnaires constructed according to classical test theory and item-response theory.

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The monitoring of sight-threatening eye diseases and the follow-up of ophthalmic treatments has traditionally focused on clinical assessment of visual acuity. Over the past 20 years, however, the use of patient-reported outcomes (questionnaires) as an additional measure of surgical outcome has increased. The reason for this is obvious. The patient does not seek help because of a specific medical measure but for his or her observed problems. It is thus reasonable to evaluate medical treatment using the patient's reported outcomes.

Questionnaires are said to measure different traits: visual disability, visual function, or difficulties in performing daily-life activities. They are the same thing, and in this review, we use the term *activity limitation* in accordance with the World Health Organization recommendation. Vision-related quality of life is a complex concept encompassing the aspects of vision loss in a person; it should include well-being, concerns, convenience. There are few comprehensive, vision-related quality-of-life instruments. Unfortunately, the term *quality of life* is often misused to describe activity limitation instruments. For cataract surgery, the traditional indication is activity limitation, so this is the appropriate trait for measuring patient-reported outcomes in cataract surgery.

Many activity limitation instruments for cataract surgery have been developed since 1992. Although a few informal instruments were developed prior to 1992, the first thoroughly developed, vision-related activity limitation instruments were introduced in that year. Therefore, our review begins in 1992. The first questionnaires were developed using the classical test theory. The instruments use Likert or summary scoring in which ordinal values assigned to response categories are summed to produce an overall score. The assumption in Likert scoring means that these scores cannot be interpreted as measurements.[1] An alternative approach is the item-response theory in which items and persons can be scaled according to a series of responses to items by a group of people. A type of item-response theory that suits questionnaire measurement was developed by the Danish mathematician Georg Rasch.[2] Rasch analysis provides the tools to measure activity limitation on an interval scale.[1] It also provides information about content validity and targeting of item difficulty to patient ability in a unique way. The use of Rasch analysis to develop new questionnaires and shorten or revise existing questionnaires developed with older techniques represents a paradigm shift in patient-reported measurement.[3] Many vision-related activity limitation instruments have been revalidated by Rasch analysis.

PURPOSE

This review describes instruments for measuring the vision-related activity limitation for cataract surgery

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outcome; the review period is from January 1992 to April 2010. The review is confined to psychometric properties of the instruments, not their use in different clinical situations. It focuses on conventional development and validation and Rasch analysis validation of these instruments.

METHODS

The search for studies about vision-related activity limitation instruments was performed primarily via Entrez PubMed. Articles were excluded from the review if they were not written in English or if they contained no abstracts or descriptions of the questionnaire used. Symptom-oriented questionnaires and pilot studies for not yet completed questionnaires were also excluded. Tests on patient categories other than cataract surgery patients were not included. Some instruments were originally developed for other patient categories or mixed-patient categories, and these initial psychometric tests were not included. If a Rasch analysis was performed later on cataract patients, the test was included.

Instruments for pseudophakic patients were not included.

The instruments were assessed on 3 aspects: A, property of the instrument according to the description of the development; B, performance of the instrument according to published tests and/or additional psychometric tests; C, Rasch analysis of the original or reengineered instrument. Because the article contents varied, all details in the articles were not included. The search terms are described in Table 1.

The assessment of instruments is based on criteria suggested by Pesudovs et al.[4] and outlined in Table 2 (classical test theory–developed instruments) and Table 3 (instruments developed or revised through Rasch analysis). When the instruments are described in Tables 4 and 5 according to these criteria, only published information is noted; no criteria means the information is not available in the literature.

Table 1. Search terms.

Search Term	Hits	Relevant	Unique
Patient questionnaire and cataract surgery	395	45	45
VF-14 and cataract	86	19	10
NEI VFQ-25 and cataract	17	6	4
VFQ and cataract	35	8	2
ADVS and cataract	13	6	4
VCM1 and cataract	2	1	1
VCM1	18	9	8
Catquest and cataract	18	6	0
Catquest-9SF and cataract	4	4	0
VAQ and cataract	1	1	0
VSQ and cataract	1	1	1
Rasch analysis and cataract	24	20	5
Validity cataract questionnaire	46	21	0
Total number of unique hits	—	—	**80**

ADVS = Activities of Daily Vision Scale; NEI VFQ-25 = National Eye Institute Visual Function Questionnaire; VAQ = Visual Activities Questionnaire; VCM1 = Vision Core Measure 1; VF-14 = Visual Function–14; VFQ = Visual Function Questionnaire; VSQ = Visual Symptoms and Quality of Life Questionnaire

One important assessment of the instruments is targeting the item difficulty to the person's ability. The indication for surgery has changed over time, and people with less activity limitation are now operated on.[5] Older instruments may be less targeted. Therefore, information about the test population and year of construction is given.

INSTRUMENTS

Activities of Daily Vision Scale

The Activities of Daily Vision Scale (ADVS) (Tables 4 and 5) was originally published in 1992 by Mangione et al.[6]

A. The overall score of the 22-item ADVS was defined as the mean of the difficulty ratings of all items. In the original publication, the internal consistency of all items was high (Cronbach $\alpha = >0.90$) and test-retest reliability was also high (Spearman correlation coefficient = 0.87 for the overall score).[6] The ADVS score was correlated to 2 questions about quality of vision, and factor analysis showed unidimensionality.
B. Improvement in visual acuity is not the only factor related to an improved ADVS score after cataract surgery. Improvement in contrast sensitivity and reductions in disability glare were also found to correlate with an improved ADVS score.[7]
C. The validity of ADVS has been reevaluated using Rasch analysis, which revealed inadequacies; specifically, ceiling effects, empty response categories, and failure to reflect vision-related quality of life in more able subjects.[8] In another study, [9] the subscales of ADVS were examined by Rasch analysis. Only 1 (near vision) of the 5 subscales showed sufficient properties to be a valid measure. The study also revealed multidimensionality of the ADVS.

Conclusion Rasch analysis showed that the ADVS is not a valid measure. For cataract patients in the developed world with minor visual disability, the instrument shows a considerable ceiling effect.

Visual Function-14

The Visual Function-14 (VF-14) (Tables 4 and 5) was originally described in 1994 by Steinberg et al.[10,11]

A. Scores on all items of the VF-14 were averaged and the average score multiplied by 25. This resulted in an index with values from 0 to 100 (most able).[10] The Cronbach α was 0.85. The VF-14 score was correlated with visual acuity in the better eye ($r = 0.27$) and with the patient's general trouble because of vision ($r = 0.45$) and satisfaction with vision ($r = 0.34$). The VF-14 score was moderately

Table 2. Quality assessment tool for questionnaires developed or tested by use of the classical test theory.

Property	Definition	Quality Criteria
Development of instrument		
Actual content area	Extent to which content meets pre-study hypothesis specifications	A Content as intended and is relevant to the intended population B Some of intended content areas missing C Content area not relevant to intended population
Item identification	Selection of items relevant to target population for inclusion in pilot instrument	A Comprehensive consulting with patients (focus groups or in-depth interview) and literature review B Minimal consultation with patients and experts opinion and literature review C No consultation with patients
Item selection	Determining items included in final instrument	A Pilot instrument was developed and tested with Rasch or factor analysis and statistical justification provided for removing items, plus items with floor and ceiling effects removed and amount of missing data considered B Only some of above techniques were used C No pilot instrument or no statistical justification of items included in the final instrument
Unidimensionality	Demonstration that all items fit with single underlying construct	A Cronbach $\alpha > 0.8$ and < 0.9 or factor analysis on raw scores (1st factor loadings > 0.4 for all items) B Cronbach $\alpha > 0.7$ and < 0.9 or factor analysis on raw scores (1st factor loadings > 0.4 for all items) C Cronbach $\alpha < 0.7$ or > 0.9
Performance of instrument (validity and reliability)		
Validity–convergent validity	Amount of correlation with related measure	A Tested against appropriate measure, correlates between 0.3 and 0.9 B Debatable choice of measure, but correlation between 0.3 and 0.9 C Tested and correlates < 0.3 or > 0.9
Discriminant validity	Degree to which instrument is not similar to (diverges from) other instruments that it should not be similar to	A Tested against appropriate measure, correlates < 0.3 B Debatable choice of measure, but correlation between < 0.3 C Tested and correlates > 0.3
Test-retest agreement	Extent to which results are repeatable when taken by same observer	A LOA appear tight and less than MID or weighted Kappa or ICC ≥ 0.8 (T-R) or 0.70 (intermode)
Interobserver agreement/ intermode agreement	Extent to which the results are repeatable between observers/ extent to which results are repeatable between modes of administration	B LOA broader but close to MID or weighted Kappa or ICC 0.60 to 0.79 (T-R) or 0.50 to 0.69 (intermode) C LOA $>>$ MID, weighted Kappa or ICC < 0.60 (T-R) or 0.50 (intermode) or incorrect statistical test or inadequate sample (< 30 subjects)

(*continued on next page*)

Table 2. (cont.)

Property	Definition	Quality Criteria
Interpretation	Extent to which score differences are meaningful	A Normative data (mean scores and SD) and MID given for representative target population; and test population demographic reported B MID or normative data or demographic details of study populations or ad hoc population C No normative data and no MID
Responsiveness	Extent to which instrument can detect clinically important changes over time	A Score changes >MID for measures of progression over time or changes with intervention; effect of size or responsiveness statistic given B Changes over time but relationship to MID not reported; small sample, inadequate time frame C Score changes ≤ MID
Burden	Time to fill in the questionnaire	A 10 items or fewer with 5 response categories at the most (≤50 decisions) B 11–20 items with 5 response categories at the most (≤100 decisions) C More than 20 items with at least 5 response categories or more (>100 decisions)
Test population and year of test		

A = excellent; B = fair/OK; C = unsatisfactory; ICC = intraclass correlation coefficient; LOA = limits of agreement; MID = minimally important difference

correlated with the Sickness Impact Profile (SIP)[12] score ($r = -0.39$) and more strongly correlated with the Vision-Related SIP score ($r = -0.57$).

B. The VF-14 was highly reproducible when test-retest reliability was studied 4 and 12 months after surgery in stable patients (intraclass correlation coefficient = 0.79).[13] A shortened version of VF-14 was studied, and 11 items had the same properties as the original 14; however, the authors did not recommend changing the already validated instrument.[14] A cross-cultural comparison of VF-14 was performed on subjects from Korea and the United States. The study found significant differences between subjects in the 2 countries, and it was concluded that cross-cultural differences should be considered when making international comparisons of quality of life.[15] A Chinese version, incorporating minor changes to the items, was tested on Chinese-speaking inhabitants of Canada. The Chinese version displayed good psychometric properties according to the authors.[16] An Australian study[17] found that VF-14 could be reduced to 7 items while preserving its psychometric properties; however, these 7 items were not the same as those in the previously published VF-7 from Finland.[18] The author stated that this difference reflected different life styles and preferences in the 2 countries.[17]

A study of subjects scheduled for cataract surgery found that utility (verbal rating and standard gamble) was more strongly correlated with VF-14 scores than with generic measures of health, such as SF-36.[19] A utility-based generic instrument was compared with VF-14 in subjects who had uneventful cataract surgery. The VF-14 was more sensitive to changes in quality of life after cataract surgery than was the utility-based instrument.[20]

C. A Rasch analysis was applied to VF-14 as used on subjects about to have cataract surgery, revealing limitations in the original instrument. An instrument that contained the VF-14 plus an additional 10 items that were developed for the study was tested. The rating scale could be converted to a 3-point scale and the number of items reduced to 10 while the instrument retained its psychometric properties.[21] The person separation was 2.20 and Cronbach α was 0.89. However, there was a ceiling effect. In another study,[22] it was shown that a 7-item subset showed the best separation ratio while the 14-item instrument showed the best Cronbach α. Thus, Rasch measurement can be helpful in selecting items for maintaining the best

Table 3. Quality assessment tool for questionnaires developed or tested by item-response theory (Rasch analysis in this review).

Ordered thresholds between response probabilities	
Meaning	Item categories chosen by respondent in logical and ordered way and related to ability of respondent.
Evaluation	If disordered thresholds, the questionnaire is useless. No further testing performed.
Dimensionality using principal components analysis (PCA)	
Assessed in 3 ways: (1) by comparing the amount of variance explained empirically and by model; (2) by evaluating amount of variance explained by first model; (3) by examining pattern loadings of first component to determine subsets of items	
PCA scoring	A: Variance explained empirically and by model equal (within 1%), Eigenvalue <2.0, no indication of subsets of items B: Variance explained empirically and by model differs within 3%, Eigenvalue <2.0, no indication of subsets of items C: Variance explained empirically and by model differ >3%, Eigenvalue ≥2.0, indication of subsets of items
Person separation	
Meaning	To reliably distinguish among several groups of patients = differentiate between several strata of person ability. Person separation should be >2.0; over 2.50 is excellent.
Reliability	The separation reliability coefficient represents the precision of the item measures. A coefficient of 0.80 is a minimum.
Scoring	A: ≥2.50, α ≥0.80; B: 2.0–2.49, α≥0.80; C: <2.0, α<0.80
Different item functioning (DIF)	
Meaning	DIF occurs when given the same level of latent trait, difficulty levels of items vary systematically based on sample characteristics.
Evaluation	Magnitude: <0.50 logits: insignificant, 0.50–1.0 logits: mild, >1.0 logits: notable
DIF scoring	A: All items with DIF <0.50 logits; B: some items 0.50 – 1.0 logits and one at the most >1.0 logits; C: more than one item >1.0 logits DIF.
Item fit	
Meaning	Infit/outfit mean square monitor compatibility of raw data with Rasch model. Each item should contribute to a picture of the respondent's ability in a predictable way. Similar to PCA, this is a test of dimensionality.
Evaluation	Both fit statistics should have value of 1 with suggested limits of 0.7 and 1.3.
Item fit scoring	A: All items with infit and outfit mean square between 0.7 and 1.3. B: One or two items within 0.65 and 1.4 limit. C: More than two items outside the 0.7–1.3 limit.

A = excellent; B = fair/OK; C = unsatisfactory

precision of an instrument. A Spanish version of VF-14 was Rasch analyzed to interpret the relation between Rasch score and patient ability.[23] The study showed which activities could be performed without difficulty for different levels of Rasch score. The VF-14 showed unidimensionality, but 3 items showed some misfit. A modified version of VF-14 for an Asian population, the VF-11, was tested and Rasch analyzed on patients from Singapore and Malaysia.[24] Disordered thresholds were evident, and for 9 items, the categories were reduced from 5 to 4. The person separation reliability was 0.82. The targeting was suboptimal. Recently, different versions of the VF-14 have been compared through Rasch analysis.[25] A shortened version, the VF-8R (8 items, Rasch analyzed), showed the best psychometric properties. This version measured cataract surgery outcomes with high precision and performs better than the VF-14 in terms of measuring a single construct.[25] However, this version has poor targeting.

Conclusion The VF-14 has been much used and thoroughly studied with the classical test theory. However, Rasch analysis revealed weakness in the construction of the questionnaire; ie, disordered thresholds, ceiling effect, and suboptimal targeting. A shortened Rasch analyzed version, VF-8R, showed the best psychometric properties in a recent test.

Table 4. Questionnaires developed using CTT.

Instrument	Questionnaire Reference				
	ADVS (Original)[6,7]	VF-14 (Original)[10,11]	Catquest (Original)[28,29]	Hong Kong Cataract Questionnaire[49]	Visual Disability Assessment[33]
Development of instrument					
Actual content area	A	A	A	A	A
Item identification	B	C	A	C	A
Item selection (reduction)	C	C	C	C	A
Unidimensionality	A: α=0.94. PCA 88%	A: α=0.85	C		C: α=0.93
Performance of insturment					
Convergent validity	A: 0.37 (Spearman); visual loss. SF-36:0.31	B: VA: r = 0.27; VR-SIP: r=0.57; "satisfaction": r=0.45	A: VA: r=0.34		A: AVDS: r=-0.83
Discriminant validity					
Test-retest	A: 0.87 (Spearman)		A	A: kappa = 0.93	A: ICC: 0.98
Interobserver	A: 0.94 (Spearman)		A	C	A: ICC: 0.94
Interpretation			C	C	
Responsiveness			A	A: ES=0,68	
Practical information					
Number of items	22	18	24	20	18
Number of response categories	4	4	4	5	4
Burden	B	B	B	B	B
Target population and year of test	USA 1992	USA 1994	Sweden 1996	Hong Kong 2003	South Australia 1997

A = excellent; B = fair/OK; C = unsatisfactory; ADVS = Activities of Daily Vision Scale; CTT = classical test theory; ES = Effect Size; ICC = intraclass correlation coefficient; PCA = principal components analysis; VA = visual acuity; VF = visual function

Houston Vision Assessment Test

The Houston Vision Assessment test (HVAT) (Table 4) was described in 1995,[A] and its validity was further studied in 2000.[26]

This 10-item questionnaire is evaluated by a scoring system in which each item score is multiplied with a coefficient based on how much the limitation in a daily activity is due to poor vision alone (assessed by the patient). The scores are summarized and multiplied by 4, giving a total range of 1 to 100.

A. The Cronbach α was 0.96 before surgery and 0.94 after surgery. The HVAT item-to-total correlations ranged from 0.54 to 0.84. The instrument was sensitive in detecting changes before and after cataract surgery, although the test population was skewed toward minimal impairment before surgery. The authors concluded that the 10-items-plus-1 validity question did not impose a burden on the subject or the administering health professionals.[26]
B. No further tests have been published.
C. No Rasch analysis of the HVAT has been published (as of April 2010).

Conclusion The HVAT has not been reevaluated with item-response theory tests.

Catquest and Catquest-9SF

The Catquest (Tables 4 and 5) was originally described in 1997.[27,28]

A. Catquest contains items in 5 subscales: activity level, difficulty in performing daily-life activities, cataract symptoms, car driving, and general opinion about visual difficulty and satisfaction with vision. The response is evaluated by comparing the total score in each subscale before and after surgery and using a decision tree to grade the benefit of surgery. A strong correlation between the perceived difficulty items and (1) the global rating questions and (2) the better-eye corrected distance visual acuity (Spearman correlation coefficient =

Table 4. (Cont.)

Questionnaire Reference						
Cataract Outcomes Questionnaire[34]	The Houston Vision Assessment Test[26,27]	Impact of Cataract Surgery[43]	Visual Symptoms and Quality of Life[48]	Quality of Life and Vision Function[50]	Visual Activities[52]	Cataract TyPE Spec[54]
			A A A	A C C	A C A	A A A
	C: α = 0.96		A: α=0.87	A: α=0.89	A: α>0.80, <0.90	C: α = 0.94
A. Contrast VA: r=0.44			A: Binocular contrast sensitivity: r=0.45. SF-36: r=0.33 - r=0.14	Tested on patients with different diagnoses	A-C for different subscales	A: Overall rating of vision: r=0.54, SF-36: r=0.27.
A: ICC: 0.93			A: ICC: 0.96			
			A		C	
10 3	10	4 2 or 4	14/26 4 or 7	17 3	33 5	12 5
A	A USA 1995	A Sweden 1998	B UK 2002	B Italy 1997	C USA 1991	B USA 2002

0.60 and −0.34, respectively) was found.[27] Test-retest showed good reliability, and a significant difference in patients without cataract was also demonstrated.

B. A study of cost-effectiveness found that utilities (EuroQol-5D, the 5-item questionnaire) correlated significantly with disability scores defined by Catquest.[29]

C. A Catquest database with more than 20 000 completed questionnaires was used to make a Rasch scale revision of the instrument. Only the visual disability subscale formed a valid measurement scale. A new revised instrument, Catquest-9SF, was constructed.[30] This instrument contains the disability subscale and the global rating subscale with a total of 9 items. The Catquest-9SF showed ordered response thresholds, good person separation (2.65), and unidimensionality; all items fit a single overall construct. The score correlated with visual acuity and was highly responsive to cataract surgery.[30] The English version of Catquest was also revalidated by Rasch analysis in an Australian population, and Catquest-9SF seemed to have the same good psychometric properties in the English language version.[31]

Conclusion The Catquest-9SF gives interval scale scoring, has high precision, is short and sensitive to changes after cataract surgery, and has high effect size (improvement/standard deviation) and good targeting.

Visual Disability Assessment and the Cataract Outcomes Questionnaire

The Visual Disability Assessment (VDA) (Tables 4 and 5) was published in 1998 by Pesudovs and Coster.[32] This 18-item questionnaire contains 3 subscales. All items have 4 categories, and the evaluation is made as a mean score per subscale and total.

A. The VDA showed high reliability for both subscales and total score (total score: internal

Table 5. Instruments developed or revised by Rasch analysis.

	Questionnaire Reference							
Instrument	ADVS[8,9]	VF-14[21]	VF-14[25]	Catquest[31,32]	Impact of Cataract Surgery[44]	Visual Activities[50]	Cataract TyPE Spec Instrument[53]	Visual Functioning Index[55]
Original number of items	22	14	14	19	4	33	12	11
Judgment of original version based on Rasch	Misfitting items and poor targeting; disordered category thresholds; multi-dimensionality	Poor targeting, disordered category thresholds	Poor targeting, disordered category thresholds	Ordered category thresholds and good patient separation but multidimensional and misfiting items	Disordered category thresholds	High person separation but some items showed misfit; multidimensionality	High person separation. 1 item showed misfit	Ordered category thresholds
Items in revised version	8 (8-item near vision scale)	10, categories collapsed from 5 to 3	Test of different short forms of VF-14; psychometric properties refer to VF-8R = 8 items	Revised Catquest: 9 = Catquest-9SF	Tested with 3 or 4 items; categories collapsed into 2	13	11	11
Ordered thresholds	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Person separation	2.32	2.20	2.29	2.65	0	3.01	2.88	1.02
Person separation reliability	0.84	0.89		0.88	0	0.90	0.90	0.51
Person separation scoring	**B**	**B**		**A**	**C**	**A**	**A**	**C**
Item fit range				0.70–1.39	0.76-0.95 (3 items)	0.70–1.30	0.75–1.27	0.16–2.72
Item fit scoring				**A**	**A (for 3-item)**	**A**	**A**	**C**
Dimensionality (PCA)			E = 1.6	64,2/64,2%, E = 1.6		64.5/65.6%, E = 1.9	64.2/65.0%, E = 2.0	?
PCA scoring				**A**		**A**	**A?**	**?**
DIF	A:3, B:2, C:3			A:6, B:2, C:1		A: 13	A: 8, B:3	A: 10, B:1
DIF scoring	**B**			**A**		**A**	**A**	**A**
Targeting	"-1.66"	"1.4"		"-0.34"	"-0.47"	"-1.44"	"-1.47"	"-3.20"
Targeting scoring	**B**	**B**		**A**	**A**	**B**	**B**	**C**
Practical information								
Number of items	15	10	8	9	4	13	11	11
Number of response categories	3	3	4	4	2 or 4	5	5	2 or 3
Burden	**B**	**A**	**A**	**A**	**A**	**B**	**B**	**A**
Target population and year of test	UK 1999	USA 1999	South Australia 2008	Sweden. Data from 1995-2005	South Australia 2007	South Australia 2007	South Australia 2007	South Australia 2007

A = excellent; B = fair/OK; C = unsatisfactory; ADVS = Activities of Daily Vision Scale; CTT = classical test theory; DIF = different item functioning; ICC = intraclass correlation coefficient; LOA = limits of agreement; MID = minimally important difference; NEI VFQ = National Eye Institute Visual Function Questionnaire; PCA = principal components analysis; VA = visual acuity; VCMI = Vision Core Measurement 1; VF = visual funtion

consistency Cronbach $\alpha = 0.93$, interobserver = 0.94, and test-retest 0.98). Criterion validity was tested toward AVDS and showed high correlation ($r = -0.83$ for overall scales). Factor analysis identified 1 factor that explained 50% of the variance.[32]

B. No further tests have been published.

C. The VDA was rescaled by Rasch analysis in 270 patients before and after cataract surgery.[B] The purpose was also to shorten the questionnaire. Several VDA items poorly contributed to the measurement of visual disability, and 8 items were therefore removed. For another 3 items, the scale was reduced from 4 to 3 categories. The new 12-item questionnaire was named the Cataract Outcomes Questionnaire. The person separation was 2.05 and the reliability, 0.81. The response categories were ordered, and all items fit an overall

Table 5. (Cont.)

Questionnaire Reference							
VCM1[42]*	Impact of Visual Impairment[47]*	Quality of Life and Vision Function[51]*	Cataract Outcomes[34]	Visual Disability Assessment[35]	NEIVFQ-25 and NEIVFQ-39[40]	Cataract TyPE Spec[55]	Visual Functioning Index[57]
10	28	17	—	18	25 and 39, respectively	12	11
2 items misfit	Ordered category thresholds but misfit to the Rasch model; multidimensionality	Ordered category thresholds and good person separation; 2 items misfit		2 dimensions: Mobility/activity limitation	Multidimensionality; dysfunctional subscales; items that misfit	Ordered thresholds but 1 item misfit	Ordered thresholds but poor overall fit and large mistargeting
8	27	15	10	7 and 11	3 versions: NEI-VFQ-25 was reduced to 18 items (1), NEI-VFQ-39 was reduced to 27 items (2) and short-form of both questionnaires was constructed with 13 items (3)	11	No revised version tested
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		2.52	2.05	2.30 and 2.80		2.88	1.02
0.94	0.97	0.86	0.81		1: 0.87/0.87; 2: 0.91/0.88; 3: 0.86/0.84	0.9	0.51
A	**A**	**A**	**B**		—	**A**	**C**
		0.51–1.46			—	0.75–1.27	0.16–2.72
		B			—	**A**	**C**
Unidimensional	17% difference between negative and positive subsets	Unidimensional		2 dimensions	Unidimensional (all)	Unidimensional	—
A	**B**	**A**		**A**	**A (all)**	**A**	—
A: 8	A: 28	"some large DIF"		0 DIF and 2 minor DIF	Minor DIF (all)	Minor DIF	Minor DIF, one item
A	**A**	**B**		**A**	**A (all)**	**A**	**A**
	"-3.36"	"-2.44"		"-2.12" and "-0.75"	1: -1.68/-1.64; 2: -2/-1.94; 3:-1.48/-1.6	**"-1.47"**	"-3.20"
	C	**C**		**C and A**	**B**	**B**	**C**
8	27	15	10	7 + 11	1: 18, 2:27, 3:13	11	11
5	4	3	3 or 4	4	4	5	3
							A
A South Australia 2007	**C** South Australia 2006	**B?** South Australia 2007	**A** South Australia 2004	**B** South Australia 2008	**B** South Australia 2008	**B** South Australia 2008	South Australia 2008

construct. The items were reasonably well targeted to the subjects. The correlation with both high and low contrast visual acuity was good ($r = 0.44$). Recently, a revision of the VDA was carried out to investigate the psychometric properties of the original VDA.[33] This revision revealed that the instrument contains 2 separate dimensions: mobility and activity limitation. Both the mobility (7 items) and the activity limitation (11 items) subscales had acceptable person separation with no misfitting items. The targeting was suboptimal for mobility but good for activity limitation.[33]

Conclusion The new 12-item Cataract Outcomes Questionnaire has good precision, reliability, and internal consistency. The original VDA also had good psychometric properties but measures 2 dimensions: mobility and activity limitation.

National Eye Institute Visual Function Questionnaire

The National Eye Institute Visual Function Questionnaire (NEI VFQ) (Table 5) originally comprised 51 items and was made for a broad spectrum of eye diseases.[34,35] It was designed to measure vision-related quality of life; the 13 subscales cover vision-related activity limitation and other traits, including well-being, social roles, and pain. A shorter, 25-item version was tested and published in 2001 by Mangione et al.[36] A further improved version with interval scoring for low vision patients and 17 vision-related activity limitation items was constructed by Massof and Fletcher.[37]

A + B. Because the NEI VFQ was not tested solely for cataract surgery patients, no psychometric data will be described.

C. The NEI VFQ was recently evaluated for cataract patients using Rasch analysis.[38] Two versions were studied, the NEI VFQ-39 and the NEI VFQ-25. Both instruments showed good person separation, but the targeting was not satisfactory. There were a significant number of misfitting items and the instruments showed multidimensionality.

The NEI VFQ-39 was reduced to a 15-item visual functioning subscale and a 12-item socioemotional subscale; a total of 27 items. The NEI VFQ-25 was reduced to an 8-item visual functioning subscale and a 10-item socioemotional subscale; a total of 18 items. These 2 revised instruments possessed unidimensional scale and showed good psychometric properties. However, there were still redundant items and therefore further reduction of items was tested.

During the reengineering phase, one 13-item instrument was constructed from 2 original subscales in both instruments: 1 short-form subscale for visual functioning and 1 short-form subscale for socioemotional matters. The short-form subscale for visual functioning contained 6 items and was unidimensional; it showed acceptable person separation, but the targeting was suboptimal, with lack of items for the more able patients. The short-form subscale for socioemotional matters contained 7 items and was unidimensional; it showed minimally acceptable person separation and suboptimal targeting.[38]

Conclusion The original versions of NEI VFQ-39 and NEI VFQ-25 showed lack of unidimensionality and contained a significant number of misfitting items. The Rasch analysis and reengineering of the instruments resulted in a 27-item version of NEI VFQ-39 and an 18-item version of NEI VFQ-25. Both revised versions seemed to be valid measures according to the Rasch analysis. A 13-item version was also derived from both instruments, and this short-form version also showed good psychometric properties. However, all 3 revised instruments showed poor targeting, with a lack of items for the more able patients.

Vision Core Measurement 1

The Vision Core Measurement 1 (VCM1) (Table 5) was developed to be a core questionnaire for vision-related quality-of-life assessment.[39]

A + B. Because the VCM1 was not tested solely for cataract surgery patients, no psychometric data will be described. Notably, it was described as a core set of 10 items to which additional items could be added.

C. The VCM1 questionnaire has been evaluated in low-vision patients and cataract patients using Rasch analysis.[40] The results for each patient group were given. For cataract patients, disordering of category thresholds was evident. Collapsing categories produced ordered thresholds and resulted in fit to the Rasch model. However, item targeting was suboptimal for the cataract population. According to the authors, the VCM1 requires addition of items to satisfactorily target cataract populations.

Conclusion The VCM1 was not constructed for cataract patients alone but has been reevaluated for this patient group by Rasch analysis. The questionnaire needs additional items to target cataract patients.

Impact of Cataract Surgery Questionnaire

The Impact of Cataract Surgery questionnaire (Tables 4 and 5) was published in 1999 by Mönestam and Wachtmeister.[41] It is a 4-item questionnaire using 2–4 categories and evaluated by adding the achieved scores.

A. There was a significant correlation between the preoperative questionnaire score and visual acuity in the better eye. Cataract surgery improved the questionnaire score, and there was a strong correlation between this improvement and the visual acuity improvement in the operated eye.

B. The questionnaire was used in a number of published studies, but no further validation study was published.

C. The questionnaire has been reevaluated by Rasch analysis.[42] It showed a poor discriminatory ability (person separation = 0) and misfit was observed for 1 item (1 of 4). The categories showed disordered thresholds.

Conclusion The Impact of Cataract Surgery Questionnaire appears unsuitable for measuring disability in patients waiting for cataract surgery. It does not meet the requirements of the Rasch model.

Impact of Vision Impairment Questionnaire

The Impact of Vision Impairment Questionnaire (IVI) (Table 5) was originally validated in people with low vision.[43]

A + B. Because it was not tested for cataract surgery patients solely, no psychometric data will be described.

C. The IVI has been evaluated with Rasch analysis for both low-vision patients[44] and cataract patients.[45] In the first evaluation, the original number of items was reduced to 28. The response scale was 4-category for 26 items and 3-category for 2 items.[44] This revised questionnaire was used in the Rasch analysis in cataract patients.[45] One item did not fit and was removed. The choice of response categories was not optimal, and the targeting was not appropriate, so many patients had no problem with the most difficult activities. Principal components analysis found evidence of multidimensionality.[45]

Conclusion The overall score from 3 subscales in the IVI questionnaire can be used as a cataract outcome measure but is not ideal because it lacks items to target more able patients.

Visual Symptoms and Quality of Life Questionnaire

The Visual Symptoms and Quality of Life Questionnaire (VSQ) (Table 4) was published in 2003 by Donovan et al.[46] The questionnaire exists in a 14-item short form and a 26-item long form. The short form consists of 2 subscales for (1) symptoms and visual dysfunction and (2) vision-specific quality of life items. The evaluation is made by adding scores from each item in subscales and in total.

A. The internal consistency was high (Cronbach α = 0.87 and 0.84 for dysfunction and quality of life items, respectively). Test-retest analysis showed an intraclass correlation coefficient of 0.96 for dysfunction and 0.95 for the quality of life area. The VSQ questionnaire was highly responsive to outcome of cataract surgery.
B. No further test studies have been published.
C. No Rasch analysis of the VSQ questionnaire has been published.

Conclusion As of April 2010, the VSQ questionnaire had not been reevaluated with item-response theory tests.

Hong Kong Cataract Questionnaire

The Hong Kong Cataract Questionnaire (Table 4) was published in 2003 and includes questions about difficulties performing daily-life activities and cataract symptoms.[47] It is a 20-item questionnaire with a 5-point scale. The result is evaluated as an overall mean score.

A. The internal consistency, Cronbach α, was 0.92. Test-retest reliability was 0.93 (overall weighted kappa). The preoperative score had a strong negative correlation with the improvement (score) ($r = -0.65$).
B. No further validity tests have been published.
C. No Rasch analysis has been published.

Conclusion The Hong Kong questionnaire has not been reevaluated with item-response theory tests.

Quality of Life and Vision Function Questionnaire

The Quality of Life and Vision Function Questionnaire (Tables 4 and 5) was published in 1998.[48] It was administered to patients with different eye diseases, including age-related cataract. The questionnaire consists of 17 questions grouped into 6 subgroups, and each question is rated on a 3-point scale.

A. The psychometric properties of the questionnaire were tested in a group of patients with mixed diagnoses.[48] Because of this, no conclusions can be drawn for cataract surgery patients.
B. No further validity tests have been published.
C. The questionnaire has been revalidated for cataract patients by Rasch analysis.[49] The category thresholds were ordered, but 2 items misfit. After excluding these items, the 15-item questionnaire performed well on most aspects: discrimination ability was good, all items fit, and the response scale functions well. However, there was poor targeting of item difficulty for more able patients.

Conclusion The Quality of Life and Vision Function Questionnaire in its 15-item revised version seems to behave well from a psychometric point of view. However, the items are poorly targeted to the ability of cataract populations in a modern developed country.

Visual Activities Questionnaire

The Visual Activities Questionnaire (VAQ) (Tables 4 and 5) was published in 1992.[50] It was targeted at older adults with vision impairment and was also intended to show the impact of treatments such as cataract surgery. The questionnaire has 33 items divided into 8 subscales; each item has 5 response categories.

A. Each subscale was tested for unidimensionality, and Cronbach α was between 0.8 and 0.9 except for glare (0.98). The convergent validity was tested against different visual function tests; some correlations exceeded 0.3, but most did not.
B. No further validation tests have been published.
C. The questionnaire has been validated by Rasch analysis.[51] The original 33-item version showed ordered thresholds, excellent person separation, and acceptable targeting. However, items showed misfit in the Rasch model and multidimensionality. Because of this, the items were reduced to 13. The 13-item revised VAQ was unidimensional. The items showed suboptimal targeting, with no questions for more able patients.

Conclusion The revised 13-item VAQ behaves as a valid measure but shows poor targeting to the more able cataract patients.

Cataract TyPE Specification Questionnaire

The Cataract TyPE Specification Questionnaire (Tables 4 and 5) was described in 2003.[52] It is a 12-item questionnaire constructed for cataract patients and assesses visual functioning in 5 dimensions. One important aim with this instrument is that it should be appropriate as a postal questionnaire (mailed to patients and self-administered). Each question has 5 response options, and summary scoring is used for evaluation.

A. The questionnaire was validated on 1823 patients in a multicenter study. The internal validity was good (Cronbach $\alpha = 0.94$) irrespective of how the questionnaire was administered. The criterion validity was good when tested against both overall rating of vision ($r = 0.54$) and SF-36 ($r = 0.27$).
B. No further validation tests have been published.
C. The questionnaire has been validated by Rasch analysis.[53] There was no evidence of disordered thresholds, but 1 item showed significant misfit. The remaining 11 items showed good person separation (2.88). The questionnaire showed unidimensionality and was largely free of differential item functioning. There was a small mistargeting, with lack of items for the more able patients. Only 2 of the supposed subscales were valid, but as a whole, the 11-item version of the instrument was valid and reliable.

Conclusion The Cataract TyPE Specification Questionnaire in its revised 11-item form is a good measure of visual functioning in cataract patients. Additional items to suit the more able patients could improve the measurement properties.

Visual Functioning Index

The Visual Functioning Index (VFI) (Table 5) is an 11-item questionnaire for cataract patients published in its final form in 1985.[54] This is before the period covered in this review, but the instrument was recently revised by Rasch analysis[55] and is therefore included.

A + B. No comments.

C. The questionnaire did not form a valid measure, with poor person separation. There was significant mistargeting, and most patients had maximum score because of no difficulty with the tasks included in the items. There was no disordering of category thresholds.

Conclusion The VFI in its present form does not appear suited to a modern cataract surgery population in a developed country, and suboptimal targeting will limit its use.

DISCUSSION

Many questionnaires for cataract patients have been constructed. The purpose of this study was to evaluate the questionnaires aimed at measuring patients' self-assessed difficulties in performing daily-life activities because of cataract. For most of the questionnaires, the aim was to measure the level of disability before surgery and the improvement after surgery. During the first 20 years of the review period, questionnaires were constructed according to the classical test theory and this technique was generally accepted as the standard technique.

More recently, item-response theory has become the gold standard for construction of patient questionnaires. Therefore, this review contains an evaluation of psychometric properties of the instruments with regard to both theories. Many of the published questionnaires from the classical test theory–era have been revalidated using item-response theory. The arguments for using questionnaires constructed or revised by item-response theory have been extensively described.[1,3,4]

Most of the reviewed questionnaires were constructed in highly developed countries. This fact is reflected in the choice of items. Although it is true that

patient questionnaires are very sensitive to cultural differences, most published questionnaires for cataract patients contain very similar items. However, there is another important detail that influences the usefulness of a specific questionnaire in a specific country. The item difficulty in the questionnaire reflects the average ability of cataract patients in the country in which the instrument was validated at the time the questionnaire was constructed. We know that the level of vision and thereby disability at the time of surgery varies between countries[56] and that the indications for cataract surgery have changed over time. In Sweden, 57% of patients who had cataract surgery in 1992 had a visual acuity of 0.1 or less in the cataractous eye.[57] In 2009, this number was 19%.[C] This means that the item difficulty in questionnaires tends to be more and more easy over time as the presurgery cataract population becomes more and more able. This fact is very obvious in the present review; most of the questionnaires lack items for the more able patients. To avoid this, a questionnaire could be customized to a specific population by choosing items of relevant difficulty from an item bank.[58] In this way, differences in both ability and cultural behavior could be taken care of in the choice of items. We believe this will be the method of constructing a patient questionnaire in the future.

We strongly advise that anyone who wants to use a patient questionnaire in clinical or research work use a questionnaire that is constructed or revised by Rasch analysis. Two instruments can be recommended because of their psychometric properties, targeting, and shortness. They are the Catquest-9SF and the 11-item revised Cataract TyPE Specification.

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