

# Development of an Elderly Low Vision Quality of Life Questionnaire for less-developed areas of China

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## Abstract

**Purpose** To develop a quality of life questionnaire appropriate for elderly low-vision patients in less-developed areas of China.

**Methods** The study was conducted at the Wenzhou Medical University Affiliated Eye Hospital. In the initial development of the questionnaire, we identified visual function concerns with individual interviews and designed a questionnaire and an empirical assessment of the questionnaire. Each individual visual function concern was then transformed into a question and put into a rating scale from 0 to 4. Then, questionnaire interviews were conducted on 188 low-vision patients and 63 normal control patients for item reduction and evaluation of psychometric properties.

**Results** We first identified 24 concerns that older adults with serious vision loss thought most affected their daily lives. The initial item list of the Elderly Low Vision Quality of Life Questionnaire (ELVQoL) consisted of 28 items, including the 24 identified items and 4 additional concerns about general vision. Psychometric item reduction removed 9 items, and a 19-item questionnaire was generated. Assessment showed that the resulting

questionnaire had acceptable internal consistency, reliability, and validity (Cronbach's  $\alpha > 0.9$ , mean item–total correlations  $> 0.6$ , test–retest reliability  $> 0.9$ , and concurrent validity range from 0.6 to 0.9). Low education level, need for a full range of working distances, and retinal diseases were all predictors of reduced visually related quality of life.

**Conclusions** A patient-derived ELVQoL Questionnaire was developed specifically for elderly, uneducated, rural Chinese. All the psychometric properties met accepted levels for a disease-specific QoL Questionnaire.

**Keywords** Low vision · Quality of life · Elderly · Individual interview · Reliability · Validity

## Abbreviations

|           |  |
|-----------|--|
| AS-20     | Adult Strabismus Questionnaire   |
| ADVS      | Activities of Daily Vision Scale   |
| CLVQOL    | Chinese version of the Low Vision Quality of Life Questionnaire                      |
| ELVQoL    | Elderly Low Vision Quality of Life Questionnaire                                     |
| FVQ-CYP   | Functional Vision Questionnaire for children and young people with visual impairment |
| IND-VFQ   | Indian Vision Function Questionnaire   |
| LVQOL     | Low Vision Quality of Life Questionnaire   |
| MGQ       | Myasthenia Gravis Questionnaire  |
| NEI-VFQ25 | National Eye Institute Visual Function Questionnaire 25                              |
| VF-14     | Visual Functional Index 14   |
| VCM1      | Vision-Related Quality of Life Core Measure  |
| VDQ       | Visual Disability Questionnaire  |
| VRQoL     | Vision-related quality of life   |

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## Introduction

The World Health Organization (WHO) reported in 2010 that there were 285 million visually impaired people in the world, of whom 246 million had low vision and 39 million were blind [1]. More than 82 % of them were at least 50 years old. In China, the number of people with low vision and blindness is 67.26 and 8.25 million, respectively, accounting for 27.3 and 20.9 % of the afflicted global population [1]. The proportion of aging people is increasing in China and half of the Chinese population live in rural areas (50.32 %, National Statistics Bureau, the Sixth National Demographic Census) where medical resources are less available than in Chinese cities [2]. Living circumstances of the visually impaired population in rural China are more difficult than those of city populations and require more attention for their resolution. Furthermore, China has 20 % of the world's population but more than its share of people with low vision, so it has an additional incentive to assess these problems and remedy them.

Over the past three decades, vision-related quality of life (VRQoL) studies have shown that impaired vision reduces visual functioning in general. It is generally accepted that self-report outcomes revealed by visually impaired patients through QoL Questionnaires are critical for assessing a patient's vision rehabilitation plan, patient satisfaction with treatments, and cost-effectiveness [3, 4]. Generic instruments such as the National Eye Institute Visual Function Questionnaire 25 (NEI-VFQ25) [5], the Visual Functional Index 14 (VF-14) [6], Activities of Daily Vision Scale (ADVS) [7], Activity Inventory (AI) [8], and the Indian Vision Function Questionnaire (IND-VFQ) [9] are used successfully in the assessment of VRQoL. Visual function questionnaires, such as the Low Vision Quality of Life Questionnaire (LVQOL) [10] and the Vision-related quality of life core measure (VCM1) [11], are specifically designed for severely visually impaired patients in developed countries. There is also the Visual Disability Questionnaire (VDQ) for developing countries such as India [12]. Of these instruments, NEI-VFQ25 and LVQOL are accepted questionnaires used to assess patients with a broad range of vision reducing ocular conditions [4]. They are designed for use across all age groups, not specifically by the elderly [5, 10, 13].

Despite the availability of these instruments, there is still no low-vision questionnaire specifically for Chinese low-vision patients. Visual function questionnaires used in China are simply adaptations from abroad. The Chinese version of the Low Vision Quality of Life Questionnaire (CLVQOL) [14] was translated from the LVQOL and validated in Shanghai, one of the most modern cities in

China. The mean age of male and female patients enrolled in the study was 48 and 57 years, respectively, a sample not representative of the elderly. Our concern is that the LVQOL was developed from a literature review by experts and not from the patients' own perspectives. Whether the CLVQOL can be used on low-vision patients living in rural areas of China has not been determined.

For these reasons, we designed a QoL Questionnaire for application in the elderly low-vision patients in rural areas of China. We do not consider this to be an instrument designed for the broad Chinese low-vision population, but rather one that is condition- and population-specific and sensitive to existing QoL factors as well as how these might change over time and with interventions [15–17].

Individual or group interviews are commonly used to identify concerns from the patients' perspectives [9, 15, 18–20]. Usually, group interviews are conducted with interviewees who have similar health and lifestyle conditions, so it is easy to collect a wide range of concerns with interviewee consensus. However, each patient's perspective may be influenced by others in the group because they discussed their issues. Group interviews limit our ability to learn about an individual patient's concerns that may not be voiced in public. Individual interviews, on the other hand, allow the interviewee to speak in private and at length about how they feel on any topic. Our goal was to develop a questionnaire relevant to the needs of less affluent elderly Chinese low-vision patients from their individual perspectives.

## Methods

### Subjects: inclusion and exclusion criteria

The study was approved by the institutional review board of the Eye Hospital of the Wenzhou Medical University, and informed consent was obtained from each patient before participation. Many patients were illiterate, so verbal consent was sought rather than written consent. No interventions were performed on patients except for interviews of about 20-min duration. Patients were recruited from the Eye hospital of the Wenzhou Medical University between January 2011 and February 2013. Patients were interviewed on the day they were hospitalized and prior to any therapy, to avoid any significant changes due to treatments. Except for written consent, all procedures were performed in accordance with the tenets of the Declaration of Helsinki. Patient recruitment criteria were as follows: (1) at least 60 years of age, (2) resident of a rural area, small town, or less-developed region in the city, (3) cognitive ability to understand Chinese, give informed consent, and

participate in the interview, (4) habitual visual acuity of logMAR 0.5–1.3 (Snellen 20/400–20/63) in the better eye before treatment, and (5) low-vision status for at least 3 months before participation. The upper limit of logMAR 1.3 (Snellen 20/400) was set to eliminate patients with functional blindness. The habitual visual acuity of the non-low-vision patients was better than 0.5. Patients who met all recruitment criteria were interviewed.

The development of our ELVQoL was conducted in two phases. The first phase was the generation of an extended item list to create a draft questionnaire (*Item list generation*), and in this phase, 19 patients were enrolled. The second phase was to conduct the assessment of the questionnaire to ascertain whether the ELVQoL was a valid instrument (*Assessment of the instrument*). In the second phase, the responses of 251 patients were analyzed, including 188 low-vision patients and 63 non-low-vision elderly controls. Non-low-vision controls were enrolled to demonstrate the ability of our questionnaire to discriminate between low-vision and normally sighted people. Data used in all the other statistical analyses were collected from the low-vision patient group. The numbers of patients who participated in the different questionnaires are given in Table 1.

## Procedures

### Item list generation

We conducted individual interviews to elicit visual function concerns. The interviews were conducted and audio-recorded in a quiet, private room. Nine open-ended questions prepared from literature reviews [3, 5–7, 13, 15, 21–24] were presented in each interview (Table 2). Patients were encouraged to speak at length regarding their feelings and concerns about having low vision and how it impacted their lives. There were two investigators (XML and LL), both of whom received training in how to conduct individual interviews and questionnaires. Nineteen patients (Table 3) met all criteria and participated in the interviews. Recordings were transcribed word for word by a single investigator (XML). The transcripts were compared sentence by sentence with the recordings by four members of

the research team to make sure that every written sentence accurately stated what the patient said in the interview. Sentences that did not agree with the recordings were corrected. Each transcript was reviewed and summarized, and all patient statements were listed. Statements that demonstrated the same visual function concern were condensed into a single visual function item. Statements that duplicated a single concern were removed. Statements that did not relate to vision such as “I can’t walk down stairs because of arthritis” were removed. Statements that were mentioned by less than 10 % of the patients were also removed as not representing a widely held concern. This assured that all concerns generated from most of the patients’ perspectives were included.

As a control to test whether our newly generated questions were acceptable, we selected four of the most widely used general vision questions from a literature review, and added these questions to our new questionnaire. The four questions are as follows: (1) What do you think about your vision? (2) Are you satisfied about your vision? (3) Is your life disrupted by vision problems? (4) Is there anything that you cannot do because of vision? Together with the items generated in the first phase (24 items, see the “[results](#)” part), a combined item list for the ELVQoL was then generated with answers using a five-point Likert response rating scale from “no difficulty with this task (0)” to “can’t do this task because of vision (4).” A patient could also answer each item with an additional response category, “do not do this because of other reasons (n/a),” which was regarded as missing data. The ELVQoL was designed to be administered either by patients themselves or by individual interview for those patients who might have difficulty reading and writing. In our study, all the questionnaires were administered in an individual interview.

### Assessments of the instrument

The assessments of ELVQoL included item reduction and evaluation of its psychometric properties. Two experienced investigators (XL and GX) conducted the interviews. We conducted a second interview 2 weeks later for a subgroup of 47 cataract surgery patients to assess test–retest

**Table 1** Different patient samples

| Patient groups  | N               | Questionnaires |
|---|-----------------|----------------|
| Low-vision group from which two interviews were accepted by | 188             | ELVQoL         |
|   | 64              | ELVQoL, VF-25  |
|   | 58              | ELVQoL, CLVQOL |
|   | 47 <sup>a</sup> | 2 ELVQoLs      |
| Non-low-vision control group <sup>b</sup>                   | 63              | ELVQoL         |

<sup>a</sup> Only cataract patients, before surgery

<sup>b</sup> Only one interviewer

**Table 2** Open-ended questions for the individual interviews

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|  |
|--|
| What has been the greatest effect of vision impairment on your life during the last 3 months?  |
| Did you read books or newspapers or other reading materials like instructions during the past 3 months? If yes, then how has reading been affected? If not, then did you read before vision impairment?  |
| Did you need to write during the past 3 months, like signing your name on the bill? If yes, then how has writing been affected? If not, did you write before vision impairment?  |
| Do you live independently or do you need help in daily living, like personal hygiene, grooming and eating during the last 3 months? If live independently, then how has your personal life been affected during the last 3 month? If not, did you live independently before vision impairment? |
| Did you do household activities during the past 3 months, like wiping the table, laundering, cooking, and mopping the floor? If yes, then how has that been affected? If not, did you do these activities before vision impairment?  |
| How has your mobility been affected during the last 3 months? Do you have any difficulty in going outside independently? How often do you go outside?  |
| What entertainment did you have during the past 3 months? What did you do in your spare time? What about before vision impairment?   |
| How has your mood been during the past 3 months? How about before vision impairment?   |
| What social activities did you have during the past 3 months? What about before vision impairment?   |

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reliability. This group was chosen because their vision would have been relatively stable within the period between the two interviews. The first interview was conducted in the outpatient department when the cataract surgery was scheduled, and the second interview was conducted in the ward just prior to surgery. The NEI-VFQ25 and LVQOL were used as concurrent control questionnaires to assess the validity of the ELVQoL. These control questionnaires were given as follows: 64 low-vision patients answered ELVQoL and NEI-VFQ25, and a partition of 58 patients answered ELVQoL and LVQOL. Limiting patients to just two control questionnaires avoided the burden of repeating similar questions for frail patients who occasionally did not fully cooperate during the interview process.

### Statistical analysis

Pearson Chi-square test, Fisher's exact test, and Mann–Whitney *U* test were used in the comparison of three factors: sociodemographic status, ophthalmic status, and general health information between patients in the low-vision and non-low-vision groups. Scale analysis, Pearson's correlation analysis, factor analysis (principle component analysis), and linear multiple regression were conducted in the assessments of the ELVQoL. All scores were converted to the centesimal system (0–100) before analysis, which was obtained by the multiplication of scores by 25 (if scores' ratings were from 1 to 4) or by 20 (if scores' ratings were from 1 to 5). This was done to make scores comparable among ELVQoL, NEI-VFQ25, and LVQOL. Statistical analyses were conducted using SPSS 16.0. All tests were two-tailed, with a *p* value <0.05 considered significant.

### Item reduction

There is no gold standard for item reduction at this time. Rather, a group of statistical assessments is administered to questionnaire responses [25, 26]. We used six methods that covered item independence, redundancy, typicality, consistency, and the structure pattern of the questionnaire. The specific tests were variation coefficient, internal correlation, item–total correlation, Cronbach's  $\alpha$  coefficient, missing data percentage, and factor analysis. All of the methods and item reduction criteria have been described previously [19, 27–30]. Three conceptual principles were followed: (1) If three of the reduction method results were lower than a lower limiting value, the item was removed. (2) If the result of a single reduction method was much lower than the acceptable criterion, the item was removed even if the other five results were acceptable. (3) If an item was a common concern of the low-vision patients and could not be replaced by similar items, then whether or not the results were statistically acceptable, the item was retained. Our justifications for the reduction criteria were based on reference criteria from previous studies [25, 26].

### Psychometric evaluation

We applied the standard methods [10, 19, 30] for psychometric evaluation, including the determination of internal consistency, reliability, and validity. Internal consistency was evaluated using Cronbach's  $\alpha$  coefficient, split half coefficient, inter-item correlations, and item–total correlations. Test–retest reliability was evaluated to show the stability of scores between two different interviews performed by the same interviewer. Validity was

**Table 3** Sociodemographic, ophthalmic and general health information of the study subjects

| Variables                                       | Face-to-face interview <i>N</i> (%) <sup>a</sup> | Low vision <i>N</i> (%) <sup>a</sup> | Non-low vision <i>N</i> (%) <sup>a</sup> | <i>p</i> <sup>b</sup> |
|---|--|--------------------------------------|--|-----------------------|
| Age <sup>c</sup>                                | 73 (64–80) <sup>d</sup>                          | 72.6 ± 7.9                           | 70.1 ± 7.2                               | 0.028 <sup>e</sup>    |
| Gender(male)                                    | 10 (53 %)  | 73 (38.8 %)                          | 27 (42.9 %)                              | 0.572 <sup>f</sup>    |
| Education level                                 |  |                                      |  | 0.296 <sup>f</sup>    |
| Illiterate                                      | 7 (37 %)   | 72 (38.3 %)                          | 16 (25.4 %)                              |                       |
| Primary school                                  | 7 (37 %)   | 65 (34.6 %)                          | 26 (41.3 %)                              |                       |
| Middle school                                   | 3 (16 %)   | 26 (13.8 %)                          | 10 (15.9 %)                              |                       |
| High school/university/college                  | 2 (10 %)   | 24 (12.8 %)                          | 11 (17.4 %)                              |                       |
| Occupation                                      |  |                                      |  | 0.65 <sup>f</sup>     |
| Farmer  | 8 (42 %)   | 69 (36.7 %)                          | 22 (34.9 %)                              |                       |
| Housewife                                       |  | 41 (21.8 %)                          | 13 (20.6 %)                              |                       |
| Retired worker                                  | 5 (26 %)   | 41 (21.8 %)                          | 11 (17.5 %)                              |                       |
| Retired administrative staff                    | 3 (16 %)   | 11 (5.9 %)                           | 7 (11.1 %)                               |                       |
| Retired teacher                                 |  | 26 (13.8 %)                          | 10 (15.9 %)                              |                       |
| Others  | 3 (16 %)   |                                      |  |                       |
| VA better eye at distance (logMAR) <sup>g</sup> | 0.93 (0.7–1.1)                                   | 0.88 (0.70–1.00)                     | 0.40 (0.22–0.52)                         | <0.001 <sup>e</sup>   |
| Visual field loss                               | 3 (16 %)   | 119 (83.2)                           | 39 (79.6)                                | 0.501 <sup>f</sup>    |
| Other visual function complaints <sup>h</sup>   |  | 88 (55.3)                            | 36 (62.1)                                | 0.376 <sup>f</sup>    |
| Duration of vision impairment <sup>g</sup>      | 6.29 (2–7)                                       | 3.0 (1.0–6.0)                        | 3.0 (1.0–9.0)                            | 0.955 <sup>e</sup>    |
| Working distance                                |  |                                      |  | 0.932 <sup>i</sup>    |
| Mainly long distance                            | 15 (79 %)  | 61 (34.9 %)                          | 23 (37.1 %)                              |                       |
| Mainly middle distance                          |  | 73 (41.7 %)                          | 23 (37.1 %)                              |                       |
| Mainly near distance                            | 4 (21 %)   | 34 (19.4 %)                          | 13 (21.0 %)                              |                       |
| Entire field                                    |  | 7 (4.0 %)                            | 3 (4.8 %)                                |                       |
| Ocular disorder                                 |  |                                      |  | 0.164 <sup>i</sup>    |
| Cataract  | 8 (42 %)   | 110 (58.5 %)                         | 42 (66.7 %)                              |                       |
| Pathological myopia                             | 5 (26 %)   | 27 (14.4 %)                          | 2 (3.2 %)                                |                       |
| Glaucoma  | 3 (16 %)   | 22 (11.7 %)                          | 7 (11.1 %)                               |                       |
| Retinal diseases                                | 2 (11 %)   | 22 (11.7 %)                          | 8 (12.7 %)                               |                       |
| Others  | 1 (5 %)  | 7 (3.7 %)                            | 4 (6.3 %)                                |                       |
| Auditory loss                                   |  | 32 (17.0 %)                          | 6 (9.7 %)                                | 0.222 <sup>f</sup>    |
| Systemic diseases                               |  |                                      |  | 0.386 <sup>i</sup>    |
| Diabetes  |  | 32 (17.3 %)                          | 8 (12.9 %)                               |                       |
| Hypertension                                    |  | 51 (27.6 %)                          | 17 (27.4 %)                              |                       |
| Cardiopathy                                     |  | 16 (8.6 %)                           | 4 (6.5 %)                                |                       |
| Arthritis                                       |  | 12 (6.5 %)                           | 1 (1.6 %)                                |                       |
| Other complications                             |  | 15 (8.1 %)                           | 5 (8.1 %)                                |                       |

<sup>a</sup> 19 Face-to-face interview subjects, 188 subjects in low-vision group, 63 controls in non-low-vision group<sup>b</sup> Comparison of the low-vision group and non-low-vision group. Two-tailed significance, *p* < 0.05<sup>c</sup> Age, mean ± SD<sup>d</sup> Mean (quartile)<sup>e</sup> Mann–Whitney *U*<sup>f</sup> Pearson Chi square<sup>g</sup> LogMAR and duration of vision loss, median (25–75 %)<sup>h</sup> Other visual complaints included glare, color vision changing, need a brighter or relatively dim environment to see clearly, etc.<sup>i</sup> Fisher's exact test

assessed by concurrent validity, convergent validity (strength of associations), and criterion validity. Inter-item correlations >0.8 were not acceptable, so one of the

two items was removed. We set an acceptable level for all the other coefficients at >0.6, and items with lower coefficients were removed [31, 32].



## Results

Sociodemographic, ophthalmic, and general health information are listed in Table 3. These data for the non-low-vision group patients were similar to that of the low-vision group with the exception of visual acuity (Table 3).

### Item list of the ELVQoL

Nineteen interview records met all criteria and were analyzed. A total of 514 qualified statements were generated, which were later condensed into the 23 individual visual function concerns (Table 4). Among the 23 concerns, the reading concern was divided into two items, *reading large text* and *reading regular text*, to reflect how visual acuity needs differed between the patients. So 24 items were generated. Concerns about mobility, social activities, and psychological issues were expressed frequently. Concerns about near vision tasks and independence (self-care and

household activities) were also expressed, but not as frequent as mobility or social activities. Although nine patients (47 %) reported having difficulty with reading and writing, only three patients requested rehabilitative services. The majority of patients in this study reported few complaints about their ability to perform hygiene, makeup, cleaning tables, sweeping floors, etc., except for certain details such as using household appliances (32 %) and recognizing dishes on the table (26 %). Together with the four general vision items selected from the literature review, an item list of 28 items was generated.

### Assessments of ELVQoL

Based on our three guiding conceptual principles, 9 items were removed and 19 items retained after item reduction. All the 19 items were classified into three domains through factor analysis (rotated component matrix, 3 factors explain 61 % of the total variance). Fifteen were visual function concerns; 3 concerned psychological concerns; and 1 concerned overall vision.

The psychometric properties of the ELVQoL were assessed after item reduction. The percent of missing data was lower than 15 % for all but two items: *doing housework* (16.5 %) and *reading regular text* (31.9 %). Mean inter-item correlation in the visual function and psychology domains were 0.47 and 0.61, respectively. Mean item–total correlation in visual function and the psychology domains were 0.71 and 0.86, respectively. This indicated that both scales add to the factor with a similar weight and have much in common for the responders. Because there was just one item for overall vision concerns, the inter-item correlation and item–total correlation could not be calculated. Cronbach's  $\alpha$  coefficient ( $>0.8$ ) and the split half coefficient ( $>0.7$ ) showed the ELVQoL having a good internal consistency (Table 5). With respect to retest reliability, the two interviews yielded scores that correlated significantly in all subscales.

Concurrent validity showed that the ELVQoL had a moderate-to-high correlation with both the NEI-VFQ25 and LVQOL in both the visual function domain and the psychology domain (Pearson's correlation coefficients  $>0.67$ ,  $p < 0.001$ , Table 5). In contrast, the correlation between ELVQoL and NEI-VFQ25 in the overall vision concern item was 0.10 ( $p = 0.45$ ), which is lower than the correlation between ELVQoL and LVQOL (Pearson's correlation coefficient = 0.56,  $p < 0.001$ ). Criterion validity was acceptable because the scores of non-low-vision controls were higher than those low-vision patients ( $p < 0.001$ , Table 5; Fig. 1). To take this a step further, correlation between visual acuity and QoL of patients in the low-vision group was assessed with partial correlations. Visual acuity correlated weakly with QoL in

**Table 4** Concerns generated from individual interviews

| Individual vision-related concerns                           | N (%)   |
|--|---------|
| <i>Mobility</i>  |         |
| <i>Walking in unfamiliar places</i>                          | 12 (63) |
| <i>Looking at road signs, traffic lights, license plates</i> | 10 (53) |
| <i>Walking on irregular surfaces (stairs, steps, curbs)</i>  | 9 (47)  |
| Taking a bus   | 8 (42)  |
| Walking in daytime   | 7 (37)  |
| Going out at night   | 4 (21)  |
| <i>Entertainment and social activities</i>                   |         |
| <i>Watching TV</i>   | 14 (74) |
| <i>Recognizing faces</i>                                     | 11 (58) |
| <i>Shopping</i>  | 9 (47)  |
| Joining in parties or visiting friends                       | 8 (42)  |
| Playing cards and mahjong                                    | 7 (37)  |
| Sports and gyms  | 6 (32)  |
| <i>Psychological issues</i>                                  |         |
| <i>Worrying about decreasing eyesight</i>                    | 13 (68) |
| <i>Some negative effects on emotional wellbeing</i>          | 10 (53) |
| Irritable, anxious and fragile                               | 7 (37)  |
| Feeling like a burden to others                              | 4 (21)  |
| <i>Self-care and household activities</i>                    |         |
| Using household appliances                                   | 6 (32)  |
| Recognizing dishes on the table                              | 5 (26)  |
| Looking for articles   | 4 (21)  |
| Doing housework  | 4 (21)  |
| <i>Near vision</i>   |         |
| <i>Reading (big texts and regular texts)</i>                 | 9 (47)  |
| <i>Writing regular texts</i>                                 | 9 (47)  |
| Making a phone call  | 7 (37)  |

The top ten most frequently mentioned concerns are shown in italics

**Table 5** Assessments of the designed questionnaire

| Assessment methods   | All Items         | Visual functions  | Psychology        | Overall vision |
|--|-------------------|-------------------|-------------------|----------------|
| <b>Reliability and internal consistency</b>                      |                   |                   |                   |                |
| 1. Cronbach's $\alpha$ coefficient                               | 0.92              | 0.91              | 0.83              | /              |
| 2. Split half coefficient  | 0.85 <sup>d</sup> | 0.88 <sup>e</sup> | 0.80 <sup>e</sup> | /              |
| 3. Test–retest reliability <sup>a</sup> $r^b(p)^c$               | 0.96 (<0.001)     | 0.96 (<0.001)     | 0.98 (<0.001)     | 0.81 (<0.001)  |
| 4. Inter-item correlation <sup>a</sup> range (mean) <sup>b</sup> | /                 | 0.26–0.70 (0.47)  | 0.56–0.64 (0.61)  | /              |
| 5. Item–total correlation <sup>a</sup> range (mean) <sup>b</sup> | /                 | 0.58–0.80 (0.71)  | 0.85–0.88 (0.86)  | /              |
| <b>Validity</b>  |                   |                   |                   |                |
| 1. Concurrent validity 1 <sup>f</sup> $r^b(p)^c$                 | 0.83 (<0.001)     | 0.64 (<0.001)     | 0.67 (<0.001)     | 0.56 (<0.001)  |
| 2. Concurrent validity 2 <sup>f</sup> $r^b(p)^c$                 | 0.93 (<0.001)     | 0.91 (<0.001)     | 0.84 (<0.001)     | 0.10 (0.45)    |
| 3. Criterion validity <sup>g</sup> $t^h(p)^c$                    | −9.32 (<0.001)    | −8.94 (<0.001)    | −7.00 (<0.001)    | −6.58 (<0.001) |

<sup>a</sup> Pearson's correlation tests. For test–retest reliability, the mean time-lag between the two interviews is 2 weeks and the two interviews were all conducted before surgery

<sup>b</sup> Pearson's correlation coefficients

<sup>c</sup> Two-tailed significance,  $p < 0.05$

<sup>d</sup> Equal length split half coefficient

<sup>e</sup> Unequal length split half coefficient

<sup>f</sup> LVQOL and NEI-VFQ25 were used as criterion controls in the assessment of concurrent validity 1 and concurrent validity 2, respectively

<sup>g</sup> Criterion validity was assessed by comparing the QoL of low-vision patients to non-low-vision patients. Independent samples  $t$  test was used

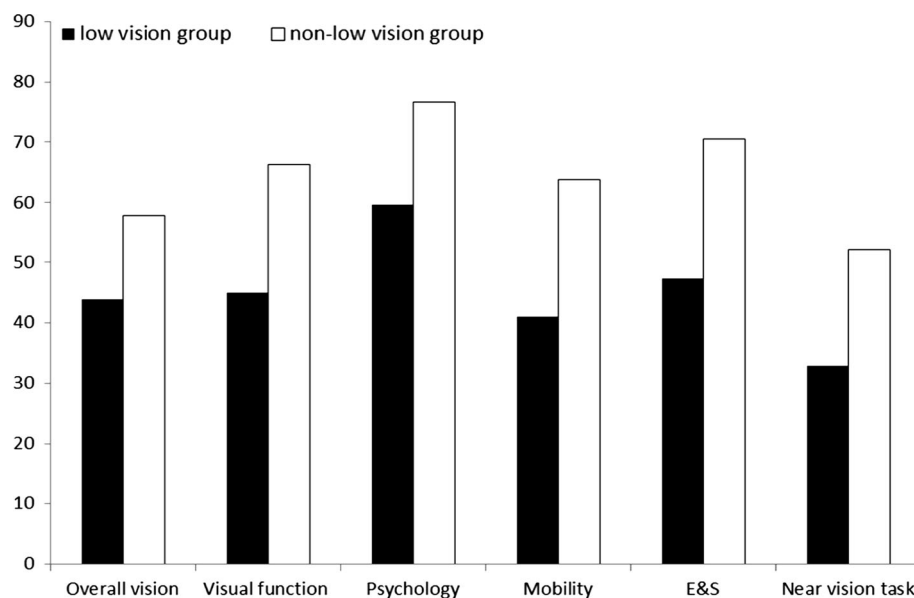
<sup>h</sup> Independent sample's  $t$  test statistics

both the visual function domain ( $r = -0.19$ ;  $p = 0.03$ ) and psychological concern domain ( $r = -0.17$ ;  $p = 0.04$ ) when visual field loss status was controlled. Convergent validity findings showed that none of the external variables was highly correlated with QoL (Table 6), but lower education level, a full range of working distances, and a longer period of vision loss were all predictors of low QoL scores.

## Discussion

The new 19-item ELVQoL Questionnaire is a short questionnaire which covers 15 items in the visual function domain, 3 items in the psychology domain and 1 item in overall vision domain. ELVQoL is a questionnaire focused on the concerns of elderly Chinese low-vision patients in rural areas. It can be completed in about 5 min in an

**Fig. 1** Comparison of mean test scores of the ELVQoL for low-vision patients and non-low-vision patients. E&S represents entertainment and social activities. The columns in black are the mean scores of low-vision patients (188) and the columns in white are the mean scores of non-low-vision patients (63). Items in mobility, E&S, and near-vision task are all included in the visual function domain, but were especially listed to show the details of QoL impact in the visual function domain



**Table 6** Linear multiple regression analysis results of the predictors of ELVQoL scores (188 patients in the low-vision group)

| External variables        | Multiple regression $\beta^a$ ( $p$ ) <sup>b</sup> |                                      |                                     |                                 |
|---------------------------|--|--------------------------------------|-------------------------------------|---------------------------------|
|                           | Sum scores of total items                          | Sum scores of visual function domain | Sum scores of overall vision domain | Sum scores of psychology domain |
| Gender                    | −0.02 (0.835)                                      | −0.02 (0.812)                        | 0.09 (0.234)                        | −0.01 (0.916)                   |
| Age                       | −0.08 (0.447)                                      | −0.11 (0.273)                        | −0.04 (0.586)                       | 0.09 (0.355)                    |
| Occupation                | −0.08 (0.476)                                      | −0.07 (0.539)                        | 0.03 (0.745)                        | −0.10 (0.371)                   |
| Education                 | <i>0.24 (0.033)</i>                                | <i>0.23 (0.044)</i>                  | 0.16 (0.092)                        | 0.18 (0.121)                    |
| Auditory loss             | −0.14 (0.111)                                      | −0.13 (0.126)                        | 0.04 (0.596)                        | −0.18 (0.085)                   |
| Systemic impact           | 0.13 (0.131)                                       | 0.14 (0.104)                         | −0.11 (0.122)                       | 0.08 (0.384)                    |
| Living alone or not       | 0.05 (0.595)                                       | 0.05 (0.571)                         | 0.09 (0.238)                        | −0.01 (0.957)                   |
| Income                    | 0.04 (0.664)                                       | 0.05 (0.596)                         | 0.02 (0.837)                        | −0.02 (0.880)                   |
| Main cause of vision loss | −0.11 (0.191)                                      | −0.10 (0.236)                        | −0.08 (0.255)                       | −0.12 (0.164)                   |
| Time of vision loss       | −0.12 (0.181)                                      | −0.10 (0.223)                        | <i>−0.18 (0.012)</i>                | −0.07 (0.398)                   |
| Working distance          | −0.03 (0.720)                                      | 0.01 (0.974)                         | −0.12 (0.130)                       | −0.17 (0.073)                   |

Significant results were shown in italic

<sup>a</sup> standardized coefficient, higher is better

<sup>b</sup> Two-tailed significance,  $p < 0.05$

individual interview without excessively burdening the patient. The questionnaire is shown in Table 7.

### VRQoL of elderly low-vision patients

We found that practical questions about difficulty with mobility, near tasks, self-care, and psychology were all elicited just as often as in previous studies. VRQoL of the studied patients was severely to moderately impaired as was shown in the decreased test scores (Fig. 1). Mobility (6 items), entertainment, and social life (4 items) were frequently mentioned by our patients, while near-vision tasks (2 items) were less frequently mentioned. The NEI-VFQ25 and LVQOL have 6 and 5 items concerning mobility, respectively, and the IND-VFQ even has an independent domain for mobility. All are consistent with ELVQoL.

Items concerning entertainment and social activities in ELVQoL (4 items) were more common than those in both NEI-VFQ25 (3 items) and LVQOL (2 items). While ELVQoL had fewer items in total (19), it had more items concerning entertainment and social activities than the other two questionnaires. ELVQoL contains only 2 items concerning near-vision tasks (*difficulty in reading regular text* and *difficulty in making a phone call*). Near vision concerns in ELQoL are not so intensive, only 2 items. While NEI-VFQ and LVQOL emphasized fine vision tasks at near, especially LVQOL, because LVQOL has about one-third (7/24) of its items concerned with near-vision tasks.

We propose two main reasons for the specificity of ELVQoL. First, our patients were significantly older (mean

age 73 years old) than those used to test other QoL instruments. Their living conditions contributed to the results: 84 % lived with family members, as is often the case in China, so that doing housework was not an essential task as shown by 16.5 % of the missing data for this activity. Forty-two percent were retired so did not encounter problems in the work place. Lack of employment and small demand for housework gave them more time for entertainment and social activities, perhaps raising the importance of these items in their domain.

Second, our sample was drawn from a different socioeconomic population than those used to develop most QoL questionnaires. The needs of undereducated small town or small city Chinese people are not the same as people living in Western-influenced urban areas of China, although this needs to be systematically demonstrated. We found an impact of low-vision status on near-vision activities as was found in similar studies [33, 34]. But our patients mentioned near-vision tasks less frequently except for reading and writing. It is true that the functional vision reserves of low-vision patients are not adequate for detailed near-vision work, but many of the patients have no need to read or write. In fact, about 38 % were illiterate and only 12 % received a high school education. These two reasons may explain why difficulties in independent living and near-vision tasks were not commonly mentioned by our patients.

Self-report measurements, such as questionnaire interviews, are highly influenced by culture, living environment, socioeconomic circumstances, and affective states. The difference between ELVQoL and similar QoL (such as



**Table 7** The Elderly Low Vision Quality of Life Questionnaire (ELVQoL)

| The Elderly Low Vision Quality of Life Questionnaire (ELVQoL)   |   |                      |                    |                    |                |                            |                                   |
|---|---|----------------------|--------------------|--------------------|----------------|----------------------------|-----------------------------------|
| Please answer the questions based on your feelings of the last 3 months. It can be self-administered or through individual interviews |   |                      |                    |                    |                |                            |                                   |
| Num   | Questions   | Responses            |                    |                    |                |                            |                                   |
|   |   | Good                 | Fair               | Poor               | Very poor      |                            |                                   |
| 1.  | How do you think about your vision?   | 4                    | 3                  | 2                  | 1              |                            |                                   |
|   | <i>Psychology</i>   | Never                | Rare               | Sometimes          | Often          |                            |                                   |
| 2.  | How often do you worry about decreasing vision?   | 4                    | 3                  | 2                  | 1              |                            |                                   |
| 3.  | How often to you feel some negative effects on emotional wellbeing?                               | 4                    | 3                  | 2                  | 1              |                            |                                   |
| 4.  | How often do you feel irritable, anxious, and fragile?  | 4                    | 3                  | 2                  | 1              |                            |                                   |
|   | <i>Do you have any difficulties in doing the following activities because of impaired vision?</i> | Not difficult at all | A little difficult | Somewhat difficult | Very difficult | Can't do because of vision | Don't do because of other reasons |
| 5.  | Walking in day time   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 6.  | Going out at night  | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 7.  | Walking in unfamiliar places  | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 8.  | Looking at road signs, traffic lights, license plates   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 9.  | Walking on irregular surfaces(stairs, steps, curbs)   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 10.   | Taking a bus  | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 11.   | Watching TV   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 12.   | Recognizing faces   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 13.   | Shopping  | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 14.   | Joining parties or visiting friends   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 15.   | Seeking articles in familiar places   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 16.   | Doing housework   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 17.   | Using household appliances  | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 18.   | Making a phone call   | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |
| 19.   | Reading regular text  | 4                    | 3                  | 2                  | 1              | 0                          | N                                 |

LVQOL) presents a strong case for using different VRQoL instruments for specific subgroups of elderly low-vision patients. Our findings support a need to develop questionnaires targeted at the specific concerns of the elderly low-vision population. Failure to do this leads to the use of inappropriate items that would increase missing data percentage and weaken the content validity. Therefore, the vision-related questionnaire would not reflect the QoL of low-vision patients effectively.

### Assessments of ELVQoL

We eliminated 9 items that failed our test of relevance. Three items (*Reading regular text items*, *Negative effects on emotional wellbeing* and *Irritable, anxious, and fragile*)

were retained even though they did not reach the standards of the first two principles. We retained these items because of their importance as near-vision task concerns and psychological concerns as seen from both the patients' perspective and previous studies [35–38]. About 47 % of the patients talked about difficulty in reading because of visual impairment, and their mean test score is only 33. About 53 and 37 % of the patients talked about the *Some negative effects on emotional wellbeing* and *Irritable, anxious, and fragile in the psychology domain*, respectively.

Psychometric evaluation results showed the final 19-item questionnaire was acceptable, showing internal constancy, reliability, and validity. The NEI-VFQ25 is a widely accepted questionnaire used in the assessment of QoL of visual impairment patients with different kinds of

eye disease, and the LVQOL is a questionnaire particularly for low-vision patients, similar to ELVQoL, but developed in a different country and socioeconomic setting. We chose the NEI-VFQ25 and LVQOL for an analysis of concurrent validity, and most of the correlations were acceptable except for the correlation between NEI-VFQ25 and ELVQoL in the overall vision domain. We presumed that this was because of the two questionnaires containing different items in the overall vision domain. The ELVQoL is a short questionnaire for elderly low-vision patients and has only one item (overall vision) in this subscale, while NEI-VFQ25 is an instrument with wider range of usage. Besides overall vision, it has items concerning general health, worrying about decreasing eyesight and ocular pain in the corresponding domain. Stronger validity correlations between the ELVQoL and LVQOL rather than between the ELVQoL and NEI-VFQ25 again demonstrated that the ELVQoL was an acceptable instrument for low-vision population.

Convergent validity results were not as good as expected. QoL is a multidimensional variable affected by many visual and external factors such as education level, financial status, age, and systemic health [39, 40]. In our study, lower education level, a full range of working distances, and a longer period of vision loss were all predictors of low QoL, but correlations were very weak. However, they lead us to realize that a full understanding of VRQoL must consider education, visual needs, and the cause of vision loss. Previous studies support this realization.

### Deficiencies in the current study

Despite psychometric results being acceptable, our initial QoL concerns were drawn from a sample of just 19 patients who cannot represent all the elderly low-vision patients with low literacy in the Wenzhou area or rural China. Open-ended individual interviews have been found too time-consuming for QoL studies, whereas small samples used have been shown to be reliable in the development of questionnaires, such as the Adult Strabismus Questionnaire (AS-20) (29) [15], Functional Vision Questionnaire for children and young people with visual impairment (FVQ-CYP) (32) [19], and Myasthenia Gravis Questionnaire (MGQ) (20) [27]. Responsiveness and rater reliability were not yet assessed in this study, which require further studies.

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### References

1. Pascolini, D., & Mariotti, S. P. (2012). Global estimates of visual impairment: 2010. *British Journal of Ophthalmology*, 96(5), 614–618.
2. Shi, X. (2009). Income Gap between urban and rural residents and improvement of social security system in China. *Productivity Research* (11), 100–103.
3. Colenbrander, A. (2010). Assessment of functional vision and its rehabilitation. *Acta Ophthalmologica*, 88(2), 163–173.
4. Binns, A. M., Bunce, C., Dickinson, C., Harper, R., Tudor-Edwards, R., Woodhouse, M., et al. (2012). How effective is low vision service provision? A systematic review. *Survey of Ophthalmology*, 57(1), 34–65.
5. Mangione, C. M., Lee, P. P., Gutierrez, P. R., Spritzer, K., Berry, S., & Hays, R. D. (2001). Development of the 25-item National Eye Institute Visual Function Questionnaire. *Archives of Ophthalmology*, 119(7), 1050–1058.
6. Steinberg, E. P., Tielsch, J. M., Schein, O. D., Javitt, J. C., Sharkey, P., Cassard, S. D., et al. (1994). The VF-14. An index of functional impairment in patients with cataract. *Archives of Ophthalmology*, 112(5), 630–638.
7. Mangione, C. M., Phillips, R. S., Seddon, J. M., Lawrence, M. G., Cook, E. F., Dailey, R., et al. (1992). Development of the 'Activities of Daily Vision Scale'. A measure of visual functional status. *Medical Care*, 30(12), 1111–1126.
8. Massof, R. W., Ahmadian, L., Grover, L. L., Deremeik, J. T., Goldstein, J. E., Rainey, C., et al. (2007). The Activity Inventory: An adaptive visual function questionnaire. *Optometry and Vision Science*, 84(8), 763–774.
9. Murthy, G. V., Gupta, S. K., Thulasiraj, R. D., Viswanath, K., Donoghue, E. M., & Fletcher, A. E. (2005). The development of the Indian vision function questionnaire: Questionnaire content. *British Journal of Ophthalmology*, 89(4), 498–503.
10. Wolffsohn, J. S., & Cochrane, A. L. (2000). Design of the low vision quality-of-life questionnaire (LVQOL) and measuring the outcome of low-vision rehabilitation. *American Journal of Ophthalmology*, 130(6), 793–802.
11. Frost, N. A., Sparrow, J. M., Durant, J. S., Donovan, J. L., Peters, T. J., & Brookes, S. T. (1998). Development of a questionnaire for measurement of vision-related quality of life. *Ophthalmic Epidemiology*, 5(4), 185–210.
12. Marella, M., Gothwal, V. K., Pesudovs, K., & Lamoureux, E. (2009). Validation of the visual disability questionnaire (VDQ) in India. *Optometry and Vision Science*, 86(7), E826–E835.
13. Mangione, C. M., Lee, P. P., Pitts, J., Gutierrez, P., Berry, S., & Hays, R. D. (1998). Psychometric properties of the National Eye Institute visual function questionnaire (NEI-VFQ). *NEI-VFQ Field Test Investigators. Arch Ophthalmol*, 116(11), 1496–1504.
14. Zou, H. D., Zhang, X., Xu, X., & Bai, L. (2005). Development and evaluation of psychometric tests of the Chinese-version of low vision quality of life questionnaire. *Zhonghua Yan Ke Za Zhi*, 41(3), 246–251.
15. Hatt, S. R., Leske, D. A., Bradley, E. A., Cole, S. R., & Holmes, J. M. (2009). Development of a quality-of-life questionnaire for adults with strabismus. *Ophthalmology*, 116(1), 139 e135–144 e135.
16. Patrick, D. L., & Deyo, R. A. (1989). Generic and disease-specific measures in assessing health status and quality of life. *Medical Care*, 27(3 Suppl), S217–S232.
17. Guyatt, G. H., Feeny, D. H., & Patrick, D. L. (1993). Measuring health-related quality of life. *Annals of Internal Medicine*, 118(8), 622–629.
18. Mangione, C. M., Berry, S., Spritzer, K., Janz, N. K., Klein, R., Owsley, C., et al. (1998). Identifying the content area for the

- 51-item National Eye Institute Visual Function Questionnaire: Results from focus groups with visually impaired persons. *Archives of Ophthalmology*, 116(2), 227–233.
19. Tadic, V., Cooper, A., Cumberland, P., Lewando-Hundt, G., & Rahi, J. S. (2013). Development of the Functional Vision Questionnaire for Children and Young People with Visual Impairment: The FVQ\_CYP. *Ophthalmology*, 120(12), 2725–2732.
  20. Rahi, J. S., Tadic, V., Keeley, S., & Lewando-Hundt, G. (2011). Capturing children and young people's perspectives to identify the content for a novel vision-related quality of life instrument. *Ophthalmology*, 118(5), 819–824.
  21. Weih, L. M., Hassell, J. B., & Keeffe, J. (2002). Assessment of the impact of vision impairment. *Investigative Ophthalmology & Visual Science*, 43(4), 927–935.
  22. Brazier, J. E., Harper, R., Jones, N. M., O'Cathain, A., Thomas, K. J., Usherwood, T., et al. (1992). Validating the SF-36 health survey questionnaire: new outcome measure for primary care. *BMJ*, 305(6846), 160–164.
  23. Scott, I. U., Smiddy, W. E., Schiffman, J., Feuer, W. J., & Pappas, C. J. (1999). Quality of life of low-vision patients and the impact of low-vision services. *American Journal of Ophthalmology*, 128(1), 54–62.
  24. Gothwal, V. K., Wright, T. A., Lamoureux, E. L., & Pesudovs, K. (2010). Activities of Daily Vision Scale: what do the subscales measure? *Investigative Ophthalmology & Visual Science*, 51(2), 694–700.
  25. Fang, J. (2000). *Determination and application of quality of life*. Beijing: Peking University Medical Press.
  26. Sun, Z. (2002). *Medical statistics* (2nd ed.). Beijing: People's Medical Publishing House.
  27. Padua, L., Evoli, A., Aprile, I., Caliandro, P., Batocchi, A. P., Punzi, C., et al. (2002). Myasthenia gravis outcome measure: development and validation of a disease-specific self-administered questionnaire. *Neurological sciences*, 23(2), 59–68.
  28. Henry, B., Aussage, P., Grosskopf, C., & Goehrs, J. M. (2003). Development of the Cystic Fibrosis Questionnaire (CFQ) for assessing quality of life in pediatric and adult patients. *Quality of Life Research*, 12(1), 63–76.
  29. Lloyd, A. J., Loftus, J., Turner, M., Lai, G., & Pleil, A. (2013). Psychometric validation of the Visual Function Questionnaire-25 in patients with diabetic macular edema. *Health Qual Life Outcomes*, 11, 10–19.
  30. Gupta, S. K., Viswanath, K., Thulasiraj, R. D., Murthy, G. V., Lamping, D. L., Smith, S. C., et al. (2005). The development of the Indian vision function questionnaire: Field testing and psychometric evaluation. *British Journal of Ophthalmology*, 89(5), 621–627.
  31. Sakane, Y., Yamaguchi, M., Yokoi, N., Uchino, M., Dogru, M., Oishi, T., et al. (2013). Development and Validation of the Dry Eye-Related Quality-of-Life Score Questionnaire. *JAMA Ophthalmology*, 131(10), 1331–1338.
  32. Naik, R. K., Gries, K. S., Rentz, A. M., Kowalski, J. W., & Revicki, D. A. (2013). Psychometric evaluation of the National Eye Institute Visual Function Questionnaire and Visual Function Questionnaire Utility Index in patients with non-infectious intermediate and posterior uveitis. *Quality of Life Research*, 22(10), 2801–2808.
  33. Paz, S. H., Slotkin, J., McKean-Cowdin, R., Lee, P., Owsley, C., Vitale, S., et al. (2013). Development of a vision-targeted health-related quality of life item measure. *Quality of Life Research*, 22(9), 2477–2487.
  34. Trento, M., Passera, P., Trevisan, M., Schellino, F., Sitia, E., Albani, S., et al. (2013). Quality of life, impaired vision and social role in people with diabetes: A multicenter observational study. *Acta Diabetologica*, 50(6), 873–877.
  35. Lamoureux, E. L., Fenwick, E., Moore, K., Klaic, M., Borschmann, K., & Hill, K. (2009). Impact of the severity of distance and near-vision impairment on depression and vision-specific quality of life in older people living in residential care. *Investigative Ophthalmology & Visual Science*, 50(9), 4103–4109.
  36. Cacho, I., Dickinson, C. M., Smith, H. J., & Harper, R. A. (2010). Clinical impairment measures and reading performance in a large age-related macular degeneration group. *Optometry and Vision Science*, 87(5), 344–349.
  37. Massof, R. W., & Fletcher, D. C. (2001). Evaluation of the NEI visual functioning questionnaire as an interval measure of visual ability in low vision. *Vision Research*, 41(3), 397–413.
  38. Gothwal, V. K., Bagga, D. K., & Sumalini, R. (2012). Rasch analysis of the Indian vision function questionnaire. *British Journal of Ophthalmology*, 96(5), 619–623.
  39. Hernandez Trillo, A., & Dickinson, C. M. (2012). The impact of visual and nonvisual factors on quality of life and adaptation in adults with visual impairment. *Investigative Ophthalmology & Visual Science*, 53(7), 4234–4241.
  40. Wilkie, R., Peat, G., Thomas, E., Hooper, H., & Croft, P. R. (2005). The Keele Assessment of Participation: a new instrument to measure participation restriction in population studies. Combined qualitative and quantitative examination of its psychometric properties. *Quality of Life Research*, 14(8), 1889–1899.