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BRIEF COMMUNICATION

Additional psychometric information and vision-specific questionnaires are available for age-related macular degeneration

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Abstract
Purpose To present psychometric information and studies dealing with questionnaires for age-related macular degeneration (AMD) and visually impaired patients in addition to the study by Finger et al. "*Quality of life in AMD: a review of available vision-specific psychometric tools*". We propose that their literature search should not have focused solely on the specific eye disease AMD.
Methods The literature search was partly replicated (PubMed) by using "visual impairment" instead of "macular degeneration" as free text words. Psychometric information was obtained from the additional studies. Preliminary results from a differential item functioning (DIF) analysis used to examine the relationship between item responses on the Vision-related quality of life Core Measure (VCM1) of AMD patients versus patients with other eye conditions are discussed.
Results Eight studies of visually impaired patient populations, including AMD patients, are discussed, with psychometric information from six vision-specific questionnaires. The VCM1 items did not present DIF, which means that the items were equally interpreted by all patients.
Conclusions The results on DIF and the additional studies presented here confirm that a specific eye disorder is of minor importance in the choice of a vision-specific questionnaire or, in this case, a literature search.

Keywords Age-related macular degeneration · Vision disorders · Low vision · Vision-related quality-of-life questionnaires · Item response theory · Differential item functioning

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The recent publication by Finger et al. [1], *Quality of life in age-related macular degeneration: a review of available vision-specific psychometric tools*, was very interesting. The authors' aim was to provide an overview of available tools and their appropriateness for use in age-related macular degeneration (AMD). Although the authors presented work of relevance for clinicians and researchers who need these specific questionnaires to evaluate the well-being of their AMD patients, not all relevant questionnaires and studies were reported.

This became clear to us because the work of Massof on visual function questionnaires (VFQs) [2], Wolffsohn et al. [3, 4] and Zou et al. [5] on the Low Vision Quality Of Life questionnaire (LVQOL), and our own work on the LVQOL and the Vision-related quality of life Core Measure (VCM1) [6–8] was absent. All these studies were carried out among visually impaired populations, which included AMD patients. Consequently, this raised questions of whether the literature-search strategy of Finger et al. should have had a more extensive reach. Similar to Finger and colleagues, we found that by entering "macular

degeneration" and "quality of life" as free text words in Pubmed, the articles mentioned above (i.e. Refs. [2–8]) did not appear in the output. However, by entering "visual impairment" as free text instead of "macular degeneration" with the same limitations as used by Finger et al. (i.e. namely, "research on human subjects after 1990") those studies did appear. This shows that more terms were required to find relevant studies, especially terms related to the consequences of the disorder, i.e. vision disability or impairment, or questionnaire names. In addition, a combination of Mesh terms and free text words may provide more relevant studies in databases such as Pubmed (which includes Medline).

The purpose of this brief communication is to present some additional information regarding psychometric data and studies dealing with vision-specific questionnaires for AMD and visually impaired patients (Table 1).

First, Massof [2] recently concluded that four VFQs, namely the Activities of Daily Living Scale (ADVS), the NEI-VFQ-25, the fourteen-item Visual Function Index (VF-14), and the Visual Activities Questionnaire (VAQ), measured the same visual ability construct; this extensive study was performed in a low-vision population ($N = 407$) of which 43% had AMD. Massof provided a scoring algorithm to be used by those who are interested in measuring visual ability. Interestingly, he confirmed that visual ability is a composite variable that has at least two dimensions:

(1) reading and visual motor tasks (which probably depend most on central vision impairments); and

(2) mobility (which might depend more on paracentral or peripheral vision impairments).

The Australian studies by Wolffsohn et al. [3, 4] reported on the design and validation of the LVQOL. The twenty-five items are mainly related to the difficulties that people have in performing some activities, because of their visual disability. Although these authors did not report the exact numbers, they did mention that some of their eligible population ($N = 515$) had AMD. They concluded that the LVQOL was a reliable and internally consistent measure for VRQOL of the visually impaired in a clinical setting [3]. In their second study among 150 visually impaired patients, approximately 25% had AMD [4].

In 2005, a Chinese version of the LVQOL was used for 100 visually impaired patients and 100 controls [5]; the authors referred to patients with AMD, but did not report the exact numbers.

The review by de Boer et al. [9] reported that the LVQOL was (at that time) one of the best for use in patients with low vision. Content validity and reproducibility had been assessed properly, but at that time construct validity and responsiveness lacked sufficient evidence. Therefore, the LVQOL was further validated, together with the VCM1. Insight into construct validity of the LVQOL and VCM1 was obtained with confirmatory factor analysis. This led to a proposal for different dimensions of the LVQOL, with relatively high Cronbach's alphas (0.77–0.90) for the dimensions "basic aspects", "mobility", "adjustment", and "reading and fine work". The ten-item VCM1 was one-dimensional; deletion of one item was suggested, however. Furthermore, test–retest reliability, minimal important difference, and smallest detectable change were assessed. In a separate study, the cross-sectional and longitudinal construct validity were investigated; this latter study was performed in a Dutch population of 329 patients with a mean age of 78.2 years (SD 9.0) of which 171 (52%) had AMD. Later, in a report on the longitudinal outcomes of low vision rehabilitation, additional comments on the validity of the LVQOL were made; in that study, we partly re-evaluated the outcomes of the LVQOL with an item response theory (IRT) model [8]. To prepare for the IRT analysis, a new factor analysis was carried out. Again, this led to a slightly different distribution of LVQOL items over sub-scales compared with the previous reports by de Boer et al. [6] and Wolffsohn et al. [3]. As a result of the IRT analysis, we found that the "reading and fine work" dimension appeared to be measuring another construct at follow-up. Therefore, this dimension was split into the subscales "reading small print" and "visual (motor) skills" to enable accurate reporting of individual and group outcomes for visually impaired patients after rehabilitation. In the near future we plan to calibrate the LVQOL dimensions in an IRT model. For the VCM1, we recently calibrated the ten items in an IRT model, which was characterized by Samejima's graded response model [10] (unpublished results).

For this brief comment, we investigated whether the calibrated VCM1 items presented with differential item functioning (DIF) between patients who had AMD ($N = 154$) as the main cause of vision loss versus patients with other eye conditions ($N = 139$) such as diabetic retinopathy, cataract, glaucoma, etc. A DIF analysis enables examination of the relationship between item responses and another variable, i.e. AMD versus other conditions, conditional on a measure (questionnaire) of an underlying construct [11]. DIF analyses were performed with software for the computation of statistics involved in IRT Likelihood-ratio tests for DIF (IRTLRDIF) by Thissen [12]. The ten VCM1 items did not present DIF, which means that the items were equally interpreted by patients with AMD and by patients with other eye disorders that caused vision loss. This finding seems to confirm that the VCM1 measures an underlying construct called "VRQOL" or "vision disability" and that a specific eye disorder is of minor importance in the choice of a VRQOL questionnaire or, in this case, a literature search. In the near future we hope to provide some more information about the psychometric properties of both the VCM1 and LVQOL based on IRT models.

Table 1 Additional vision-specific questionnaires for AMD patients

Authors	Questionnaire	Dimensions	Language	*N* (% AMD)	Psychometric information
Massof (2007) [2]	ADVS NEI-VFQ-25 VF-14 VAQ	1. Reading and visual motor tasks 2. Mobility	English	$N = 407$; 43% AMD	– Rasch model – Interval scaled scoring algorithm – Reliability of approximations of visual ability for the four questionnaires (ICC: 0.97–0.997) – Dimensionality with confirmatory factor analysis – Item and person fit, separation reliabilities: 0.98 and 0.95, respectively – Analysis with missing data possible
Wolffsohn et al. (2000) [3, 4]	LVQOL[a]	1. Distance vision, mobility, and lighting 2. Adjustment 3. Reading and fine work 4. Activities of daily living	English	$N = 150$; 25% AMD, and $N = 515$; incl. AMD[b]	– Content validity (high quality: item reduction, subscales checked, internal consistency; low quality: selecting items) – Reproducibility (medium quality: reliability; no information: agreement) – Construct validity (low quality) – Responsiveness and true linear scaling (both no information) – Interpretability and respondent burden (both medium quality)
Zou et al. (2005) [5]	LVQOL	1. General vision and lighting 2. Mobility 3. Psychological adjustment 4. Reading, fine work, and activities of daily living	Chinese	$N = 200$; incl. AMD[b]	– Construct validity: factor analysis – Internal consistency reliability (Cronbach's alpha and split half coefficient: 0.75–0.97) – Test-retest reliability (ICC: 0.69–0.95) – Item internal consistency (>0.4); discrimination validity (<0.40)
De Boer et al. (2005) [6][c] De Boer et al. (2006) [7][c]	LVQOL VCM1	– LVQOL: 1. Basic aspects 2. Mobility 3. Adjustment 4. Reading and fine work – VCM1	Dutch	$N = 329$; 52% AMD	– Confirmatory factor analysis, comparative fit index: 0.91 (LVQOL); 0.94 (VCM1) – Internal consistency reliability (Cronbach's alpha: 0.77–0.91) – Test-retest reproducibility: smallest detectable change (SDC) comprised > one quarter of the scale – Minimal important change exceeded by SDC – Cross-sectional validity satisfactory for LVQOL; poor for VCM1 – Longitudinal construct validity poor to moderate.
Van Nispen et al. (2007) [8][c]	LVQOL VCM1	– LVQOL: 1. Basic aspects 2. Mobility 3. Adjustment 4. Reading and fine work 4a. Reading small print 4b. Visual (motor) skills – VCM1	Dutch	$N = 296$; 54% AMD	– Multilevel IRT model: graded response model for rating scales – Correlation between restricted and unrestricted model (*r*: 0.976–0.997) – Dimensionality with exploratory factor analysis – Cronbach's alpha (0.82–0.93) – Differential item functioning (DIF) across time points – Analysis with missing data possible

Table 1 continued

Authors	Questionnaire	Dimensions	Language	*N* (% AMD)	Psychometric information
Langelaan et al. (2007) [13]	VFQ-25	1. Near activities 2. Distance activities and mobility 3. Mental health and dependency 4. Pain and discomfort	Dutch	$N = 129$; 9.4% macular disorders	– Rasch model – Dimensionality with exploratory factor analysis – Person separation index (0.66–0.85) – Item fit (pain and discomfort: $P = 0.03$, other dimensions P: 0.24–0.69) – DIF for age, gender, time of onset of visual impairment and social status; not for functional vision score, comorbidity, educational level

[a] Psychometric quality was assessed by de Boer et al. in a systematic review [9]

[b] Percentage AMD unknown

[c] Analyses performed on the same data set

Furthermore, Finger et al. stated that it was concluded in the review by de Boer et al. [9] that the NEI-VFQ-25 was of very high psychometric quality. It is certainly a widely used questionnaire, especially in the USA where it was developed. Although the VFQ-25 was at that time listed in the top three of questionnaires developed for people with visual impairments in general, some essential psychometric information was missing, or the psychometric quality was insufficient. Among many other psychometric quality criteria (such as reliability and responsiveness) a clear factor structure had not been investigated. That is why Langelaan et al. [13] recently performed factor, Rasch, and DIF analyses to validate the VFQ-25. A four-factor structure was found, but some modifications to the questionnaire were recommended, i.e. collapsing response categories and deleting items. The study population consisted of 129 adult visually impaired clients from an inpatient low vision rehabilitation service in the Netherlands, of which 9.4% ($N = 12$) had macular disorders. Consequently, and in contrast with Finger et al., we listed this study in Table 1, because it provides additional psychometric information. Unfortunately, Finger et al. did not adopt criteria for assessing or choosing questionnaires previously reported by de Boer et al. [9] or, more recently, by Pesudovs et al. [14].

This brief comment, together with the studies mentioned above, is by no means intended to represent a complete update of the literature. However, based on these additional studies that we know deal with VRQOL questionnaires, and the preliminary results of the DIF analysis, we believe that the literature search of Finger et al. could have been more extensive. Not focusing solely on the level of the condition (i.e. macular degeneration) may have been a better option in the search for relevant studies and questionnaires. We believe that the studies mentioned above, at least, should not be overlooked by clinicians and/or researchers who want to choose a questionnaire for evaluating AMD patients, or patients with visual impairments in general.

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