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Self-reported visual functioning and quality of life in age-related macular degeneration

Usha Chakravarthy^a and Michael Stevenson^b

Purpose of review

To review the current literature on the impact of age-related macular degeneration on self-reported visual functioning, quality of life, and independent living.

Recent findings

The quantitative relationships between visual acuity, an objective clinical measure of vision, and self-reported visual functioning have been explored and described within prospective longitudinal clinical trials. When age-related macular degeneration is bilateral, the severe and irreversible loss of central vision experienced by affected persons has been shown to result in despondency, inability to care for self or others, and a state of disutility, which is equivalent to that experienced in coronary heart disease and stroke.

Summary

Quality-of-life indicators and self-reported visual functioning have gained acceptance as key outcome measure in studies designed to test therapeutic interventions and rehabilitation strategies in age-related macular degeneration. Vision loss from age-related macular degeneration engenders a profound sense of loss and the resultant handicap has been likened to that of the most severe medical conditions.

Keywords

age-related macular degeneration, self care, self-reported visual functioning, visual function, quality of life

Introduction

It is recognized that the commonly used conventional tests of vision such as distance and near acuity simply measure resolution. Even extending the range of tests to include other clinical measures such as reading speed, color vision, contrast, visual field, and retinal sensitivity does not result in the capture of visual functioning in its totality, nor do these tests solely or jointly describe ability to undertake vision-dependent tasks. Thus, there has been growing interest in the use of semistructured questionnaires that assess self-reported visual functioning (SRVF) and health-related quality of life (HRQOL), which yield information that is not only performance based but also depicts the end-user perspective. Adding to the value of these instruments is their ease of administration and a lack of need for specialized equipment and highly trained staff, both of which are requisites for psychophysical tests of vision.

The first visual functioning instruments were devised for the purposes of understanding quality of life in persons with cataract. Given that perfect restoration of vision is common after cataract surgery, these instruments were constructed to capture deficits in visual functioning relating to binocular performance, reading, and driving, all of which presuppose good to excellent overall visual function. By contrast, age-related macular degeneration (AMD) frequently leads to severe central visual loss in one or both eyes, with no prospect of restoration of perfect function. AMD is common and accounts for more than half of all people registered as visually impaired in Western countries. With the explosion in the variety of therapies currently being tested for efficacy in exudative AMD, there is considerable interest in the development of new performance-based robust markers of outcome. Therefore, instruments that assess visual functioning and quality of life within the context of severe and permanent central visual impairment have been devised and have achieved considerable popularity.

Recent findings on vision-specific quality of life in age-related macular degeneration

The use of visual functioning instruments in clinical and population-based settings has helped enormously in the understanding of the relations between commonly used clinical measures of vision and visual disability [1]. In a study of the determinants of participation in activities of daily living, the former have been explored in some detail in people with visual impairment [2]. Lamoureux *et al.*

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Abbreviations

AMD	age-related macular degeneration
DVA	distance visual acuity
HADS	Hospital Anxiety and Depression Scale
HRQOL	health-related quality of life
IVI	Impact of Visual Impairment
NEIVFQ	National Eye Institute Visual Function Questionnaire
POMS	Profile of Mood States
SF	Short Form Health Survey
SRVF	self-reported visual functioning

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[2] enrolled 319 people who completed the impact of vision impairment (IVI) and the medical outcomes study Short Form (SF)-12 instruments. Participants also had best corrected distance visual acuity (DVA) recorded in both eyes. In persons with visual impairment (defined as having an acuity worse than 6/12 Snellen in the better-seeing eye), DVA, mental health, and physical health were the most significant determinants for participation in daily activities measured by the IVI, which were grouped under five life domains. The findings from this analysis suggest that to maximize the impact of interventions aimed at improving quality of life, approaches with a component directed at improving mental and physical health would have to be included. Interestingly, DVA, mental health, and physical health explained only one third of the variance in the IVI. Age and duration of visual impairment did not influence IVI scores in the regression models, and the authors stated that these parameters should not be assumed to influence the rehabilitation strategies that are adopted by visually impaired individuals. Despite the inclusion of participants with other visually impairing diseases, the only disorder to reach significance within the model was AMD. The authors suggested that the severity and nature of vision loss in AMD *per se* may have had a disproportionate impact on restricting participation in daily living tasks. However, they also cautioned that because more than 50% of the participants had visual impairment due to AMD, the overrepresentation of this condition relative to other disorders such as diabetic retinopathy might have accounted for its contribution to the statistical models.

Stelmack *et al.* [3,4^{*}] described the psychometric properties of a new instrument, the Veterans Affairs Low Vision Visual Functioning Questionnaire, in reports validating its use in people with low vision. This instrument has been shown to be sensitive to changes in acuity at the low end of the vision scale. The authors found high test-retest reliability and intraclass correlations of 0.98 for item measures and 0.84 for person measures. The authors have not described a domain structure for this questionnaire. As a consequence, a potential disadvantage to the users of the instrument is the need to use tests for each of the 48 items, with the associated problems of having to correct for multiple testing. Also, the issue of redundancy has not been addressed. In this context it is worth noting that the authors demonstrated that separation reliability (which they stated is similar to the Cronbach alpha) was 0.993 in their instrument. This high value is an indication of the sizable redundancy within this instrument. Despite these drawbacks, the instrument shows the range and precision necessary to measure ability to undertake vision-dependent functioning even in people with severe vision loss across diverse clinical settings.

Currently, however, the most popular instrument for measuring vision-specific quality of life is the National Eye

Institute Visual Function Questionnaire 25 (NEIVFQ25). This instrument has been extensively validated and tested in persons with low vision as well as patients with AMD, and the subscales dealing with vision-specific activities have shown to be sensitive to differences over a large range of visual acuity in several studies. Nonetheless, some studies suggest that the NEIVFQ is prone to floor and ceiling effects in patients with very poor vision and very good vision, respectively [5]. Also, subscales on ocular pain and driving are irrelevant to people with low vision, those with painless vision loss, and those who do not drive. Despite these criticisms, in a study of AMD patients seeking rehabilitation of low vision, lower scores on the NEIVFQ than those previously reported in other studies of patients with the same disorder were found [6]. The largest deficits were seen in the subscales for near and distance vision, role difficulties, dependency, social functioning, and mental health. The authors postulated that the instrument is suitable for measuring visual decline in the lower end of the visual acuity scale because it would be sensitive to improvements; hence, they recommend its use in trials of the effectiveness of low vision rehabilitation.

In a small cross-sectional study of 70 patients, Cahill *et al.* [7] found that other NEIVFQ subscales such as dependency, role limitation, mental health, and social functioning correlated weakly with visual acuity. As in other studies, the driving vision and ocular pain subscales of the NEIVFQ were least informative. The same investigators also used the NEIVFQ to assess quality of life after macular translocation surgery in a group of 50 patients and found enhanced scores in many of the subscales in patients in whom acuity improved [8]. The lack of masking and the absence of a control group in this prospective observational case series, which also had the disadvantage of a small sample size could have led to bias and overestimation of effect size.

Visual functioning as an outcome measure in interventions for age-related macular degeneration

The submacular surgery trials (trial N and trial B), which enrolled patients with subfoveal choroidal neovascularization was designed to assess the benefit of surgical removal of the choroidal neovascularization over observation while obtaining standardized information on visual acuity. These trials also concomitantly collected information on visual functioning and HRQOL [9]. Questionnaires that were administered to participants included the NEIVFQ, the Hospital Anxiety and Depression Scale (HADS), the Submacular Surgery Trials (SST) vision preference value scale, and the SF-36. Analysis of the baseline data from SST showed that acuity in the better eye was strongly associated with NEIVFQ scores but not with SF-36 or HADS scores [9]. After adjustment for visual acuity of the better eye and other factors, patients with bilateral conditions had NEIVFQ summary scores 6 points lower than did

those with unilateral conditions in the group N trial and 10 points lower than those with unilateral conditions in the group B trial. Thus, the authors concluded that choroidal neovascularization in both eyes lowers a patient's vision-specific function even after visual acuity, general health status, age, gender, and reading speed in the better eye are controlled for [9].

On longitudinal analysis, the submacular surgery pilot trials showed that visual acuity, the primary outcome parameter, was not significantly different between treatment groups [10*,11]. In the group N trial, the scores of the distance activities, general vision, and mental health subscales as well as the summary score of the NEIVFQ favored the surgery arm [10*]. Interestingly, significant differences between the treatment and control arms were not observed in most of the vision-specific subscales in this trial. In the group B trial, no statistically significant differences were observed between the treatment and control patients in any subscale or the summary score [11]. One possible explanation for the inconsistency between HRQOL outcomes in the group N trial and changes in visual acuity is that the former may have captured changes in visual function not measurable by standard means. Despite the possible HRQOL gains, the investigators cautioned that the differences in HRQOL in the treatment arm, though of benefit, were small and therefore unlikely to represent meaningful improvements in visual functioning and HRQOL.

Visual function and comorbidity

Given that AMD is a disorder of older people, the comorbidities that are common in this age group may be expected to affect the responses to visual functioning instruments, especially in items or domains that are influenced by general health status. Data from the two submacular surgery pilot studies provide some insight into the effects of coexisting medical conditions in patients with AMD. Information on best corrected DVA in both eyes was available, as were scores from the NEIVQ, SF-36, and HADS from the baseline and 24-month visits. In an exploratory analysis of the SST dataset in which data from both trial N and trial B were pooled, the investigators modeled the NEIVFQ score as a function of the physical component summary score (PCS) and mental component summary score (MCS) summary scores of the SF-36 [12]. Adjustment for comorbidities did not change the treatment effect; however, the NEIVFQ changed by as much as 4.3 in the treatment arm when adjustment was made, in comparison with the unadjusted analysis. The investigators justified their analytic approach because every domain of the NEIVFQ showed a similar trend in terms of a positive adjustment. An important caveat, though, is that the adjustments are not independent of each other because each domain of the NEIVFQ has been regressed on the same treatment and PCS/MCS scores. Therefore,

any distortion in PCS or MCS summary scores between the observation and surgical arms may be reflected in reverse by the treatment variable, which is likely to act as a differential intercept [12].

With the absence of statistically significant differences between intervention arms in the SST, the investigators combined the data on quality of life outcomes from the treatment and control groups for analysis as a cohort. Data from the SST were further analyzed to estimate the relative contributions of general health and central vision loss to vision-dependent quality of life [13]. A three-line worsening in visual acuity in the better eye was associated with a reduction of between 5.1 and 17.1 in NEIVFQ summary scores after adjustment for comorbid medical conditions as assessed by the SF-36. Conversely, a 10-point reduction in the physical component summary score of the SF-36 was associated with a 4- to 9-point fall in the NEIVFQ. Likewise, a 10-point reduction in the mental component summary score of the SF-36 resulted in a 4- to 8-point fall in the NEIVFQ. Notably, certain subscales of the NEIVFQ such as role difficulties, dependency, and mental health were strongly influenced by medical disorders, confirming intuitively held views that vision-dependent quality of life is affected both by change in visual acuity in the better eye and by general health status [13]. Although 397 participants were enrolled, only 120 complete sets of data were available at the 24-month datum point, limiting the value of the analysis. Furthermore, the length of the interval (24 months) between baseline and the follow-up visit included in the analysis may have resulted in underestimation of effect sizes, because adaptive changes could have occurred during this period.

Self-reported visual functioning as a key outcome measure

Traditionally, clinical trials of AMD have used change in visual resolution (namely, DVA) as the primary outcome parameter in ascertaining the efficacy of the planned intervention; however, patient-centered outcome measures are likely to be more pertinent and relevant surrogate markers in the testing of interventions such as visual rehabilitation strategies and prevention of depression. In a novel study design, Reeves *et al.* [14*] tested the effectiveness of three models of low-vision rehabilitation in AMD patients. For inclusion in the study, participants were required to have a primary diagnosis of AMD, with acuity worse than logMAR 0.6 in the better-seeing eye and no worse than logMAR1.6 in at least one eye. The three arms were an enhanced low-vision rehabilitation group, a conventional low-vision management strategy, and a control group whose members did not receive rehabilitation. The primary outcome was performance on the VCM1 (a vision-specific quality of life instrument) and the SF-36. The study found that enhanced low-vision

rehabilitation was no more effective than conventional strategies, and the authors cautioned against proposing new interventions without evidence of efficacy in a randomized trial setting.

In another clinical trial wherein intervention was specifically aimed at reducing emotional distress in persons with AMD, the change in emotional status was the primary outcome and was measured by use of the profile of mood states (POMS) [15^{*}]. Specifically, patients with AMD were randomly allocated to one of three groups. Group 1 received up to 12 hours of interaction, including lectures and education on social cognitive theory and the impact of AMD, while being encouraged to explore issues relating to evaluating barriers and adaptive behavior, and participating in an exercise program. Group 2 received 12 hours of tape-recorded education. Group 3 were assigned to a waiting list. The primary outcome was the change in POMS score, and secondary outcome measures included SRVF according to the NEIVFQ, self-confidence to handle AMD-specific challenges in daily life, and depression status. At 6 months, participants in group 1 reported significantly less emotional distress ($P = 0.008$), better function ($P = 0.05$), and increased self-efficacy ($P = 0.006$). When participants were classified into depressed and not depressed (based on the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders; SCID), it was clear that the treatment effect was entirely driven by the marked improvements in POMS scores seen in the depressed participants from group 1 [15^{*}]. When depression status by treatment group and time was tested, a highly significant result was seen. Although a clear and strong benefit emerged, the findings were driven by the results from 19 individuals who were in intervention group 1 and who were depressed at baseline. Therefore, the group of depressed visually impaired people would need to be compared with a group of normal-sighted depressed individuals similarly exposed to social and behavioral group therapy strategies before the results of this trial can be used to inform and change clinical practice.

Role as caregiver and dependency state in persons with age-related macular degeneration

The influence of AMD also seems to extend beyond the confines of the individual, with an additional impact on family and society. In this context, a recent study showed that visual impairment interferes with the ability to self-care and also impairs the affected person's role as a caregiver [16^{*}]. In a group of older adults with AMD, Stevenson *et al.* [16^{*}] assigned 199 participants on the basis of self-reported status into three care levels. Level 3 participants had no difficulty in providing care to others and looking after self. Participants in level 2 had difficulty only in caring for others, and those in level 1 could not care for others

or self. A clear relation with the better-seeing eye was demonstrated; level 3 participants had the best vision, and level 1 participants had the worst vision. The investigators included age, gender, SRVF measured on the Daily Living Tasks Dependent on Vision questionnaire, and the nine dimensions of the SF-36 in their regression models. Through inclusion of the SF-36, which is a generic measure of health, the investigators accounted for the presence of medical comorbid conditions that could have influenced the dependency state. To have a posterior probability of 0.5 or greater of being placed in care level 3, visual acuity had to be better than logMAR 0.5 (Snellen 6/18). Similarly, to have a probability of 0.5 or greater to be placed in care level 1, visual acuity had to be worse than 1.0 logMAR (6/60 Snellen). The most likely DVA at which placement in care level 2 occurred was an acuity of 0.7 logMAR (Snellen 6/30). The authors noted that the level of visual acuity at which the balance of probability shifted in the direction of diminished ability to provide care to others or self care was lower than that currently set by social care agencies for provision of support to visually impaired people [16^{*}].

Utility values and age-related macular degeneration

Although visual functioning questionnaires clearly show the relations between the severity of vision loss and ability to undertake tasks associated with daily living, they do not provide direct information on the disutility experienced by the person. By contrast, the time tradeoff and standard gamble methods ask the respondent a series of questions that are used to calculate utility, with a value of 1 indicating perfect satisfaction with current health and 0 indicating life not worth living. The work of Stein *et al.* [17] has provided unique insights into the disutility that arises from AMD. Utility declined with increasing visual impairment, dropping from 0.83 when impairment was mild to 0.73 when it was moderate. The utility further declined to 0.56 for severe vision loss and was on a par with systemic diseases such as stroke and myocardial infarction. Notably, the disutility calculated from the responses of persons with AMD at each of the vision impairment levels (mild, moderate, or severe) was significantly worse than that assigned from the responses of participants who were not visually impaired or clinicians involved in the treatment of patients with AMD. These findings suggest that both the general public and clinicians significantly underestimate the disutility that accompanies vision loss. The authors did not subject their data to analysis to test for differences between the general public and clinicians. On undertaking an analysis of variance (after probit transformation of the published utility values), we conclude that there was no difference between utility assigned by clinicians and the general public, but there was a strong difference between persons with AMD and the other groups.

sons with AMD. Studies on utility using the time tradeoff and standard gamble methods have shown that vision impairment from AMD results in a disutility that is comparable to that of the most severe medical conditions and that it acts as a trigger into a dependent state. Although these studies have led to a better understanding of the nature of the visual handicap in AMD, the relative importance of the specific tasks involved in daily living and the adaptive strategies assumed by persons with AMD to overcome their handicap have not yet been explored in any depth.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
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Conclusion

Over the past decade, clinicians and visual psychologists have turned their attention to visual functioning and AMD. The use of instruments that assess SRVF, HRQOL, and mental health have provided unique insights into the impact of vision loss on the health and well-being of persons with AMD. Studies on utility using the time tradeoff and standard gamble methods have shown that vision impairment from AMD results in a disutility that is comparable to that of the most severe medical conditions and that it acts as a trigger into a dependent state. Although these studies have led to a better understanding of the nature of the visual handicap in AMD, the relative importance of the specific tasks involved in daily living and the adaptive strategies assumed by persons with AMD to overcome their handicap have not yet been explored in any depth.

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