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Influence of Age-related Maculopathy on Visual Functioning and Health-related Quality of Life

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• PURPOSE: To describe the influence of age-related maculopathy on visual functioning and health-related quality of life.

• METHODS: A prospective, cross-sectional, observational cohort sample of 201 persons with various stages of age-related maculopathy was recruited from the Massachusetts Eye and Ear Infirmary as part of a longitudinal study of age-related macular degeneration. Persons were considered to have age-related maculopathy if one or more of the following clinical characteristics were present: drusen, retinal pigment epithelial changes, geographic atrophy, or evidence of exudative disease. Median corrected visual acuity for this sample was 20/25 in the better eye, with all subjects having 20/200 or better visual acuity in at least one eye at baseline. All participants underwent a comprehensive ophthalmologic examination with a dilated pupil. In addition to the usual clinical data collection, severity of age-related maculopathy was graded by an ophthalmologist who used standard clinical criteria and was masked to the participants' descriptions of visual functioning and health-related quality of life. All participants completed an interview that included the Activities of Daily Vision Scale, a survey designed to assess difficulties with routine daily activities that require vision, and the Short Form-36 Health Survey, a generic measure of multidimensional health-related quality of life.

• RESULTS: Severity of age-related maculopathy was associated with poorer scores of the Activities of Daily Vision Scale. This association was most significant for near vision and driving activities. In this sample, the SF-36 Health Survey scales were not significantly correlated with severity of age-related maculopathy.

• CONCLUSIONS: Reported visual functioning is significantly associated with the clinical severity of age-related maculopathy. However, once visual acuity is taken into consideration, clinical grading of age-related maculopathy did not explain a significant portion of the variation in visual functioning. The lack of significant correlation between severity of age-related maculopathy and the SF-36 Health Survey may have resulted from the small number of participants in our sample with severe bilateral age-related maculopathy. (Am J Ophthalmol 1999; 128:45–53. © 1999 by Elsevier Science Inc. All rights reserved.)

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OPHTHALMOLOGISTS INCREASINGLY RECOGNIZE the importance of assessing a broad array of outcomes, such as physical function, social function, and overall health, in addition to standard clinical endpoints when evaluating treatments for eye diseases[1–9]; however, measures of visual functioning and health-related quality of life have rarely been incorporated into clinical studies of age-related maculopathy.[10] Age-related maculopathy is the leading cause of irreversible blindness among elderly persons in the developed world,[11] with more than 25% of persons over age 75 years having evidence of early age-related maculopathy.[12] In a population-based nursing home study, age-related maculopathy was noted as the cause in 11% of cases of blindness.[13] By incorporating self-reports of visual functioning and health-related quality of life into clinical studies, it may be possible to demon-

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strate the negative impact of age-related maculopathy on everyday activities that are not reflected in clinical endpoints such as visual acuity or clinical severity of maculopathy.

There is a growing need to be able to explain the results of clinical studies in the metric of everyday patient functioning. Whereas clinical researchers are most interested in understanding the pathophysiology of various ocular diseases and the influence of treatment on preventing progression to visual impairment or blindness, it is the consequential impact on overall vision that makes participation in a wide range of activities possible and influences overall physical functioning and emotional well-being.[7,14–21] Loss of vision carries significant economic and psychological costs for individuals and for society.[22,23] Diminished visual acuity has been associated with decreased performance of instrumental activities of daily living, poorer cognitive abilities, increased risk of falls, and ultimately poorer health-related quality of life.[24–29] The quality of clinical research will be enhanced by a better understanding of the relationship between the pathophysiology of eye disease and patient-reported functioning.

The goals of this investigation were to determine whether self-reported vision-targeted and generic health-related quality of life questionnaires are reliable and valid tools for describing the influence of age-related maculopathy on visual functioning. Because previous research indicates that visual acuity may not fully capture the extent of visual disability from common ocular conditions,[1,5,7,8,16,17,22,29–34] we also examined the relative strength of the correlation between a clinical grading of age-related maculopathy severity and visual acuity on vision-targeted health-related quality of life.

METHODS

THIS ANCILLARY STUDY PROSPECTIVELY ENROLLED CONsecutive patients with age-related maculopathy who were scheduled for vision care by one of the authors (J.M.S.) at the Massachusetts Eye and Ear Infirmary between July 1, 1992, and September 1, 1993, as part of the Age-related Macular Degeneration Progression Study, which began in 1989. This study is an ongoing longitudinal study designed to measure multiple risk factors for progression of maculopathy.

Eligibility criteria at the baseline visit included morphologic evidence of age-related maculopathy by means of direct ophthalmoscopy, best-corrected visual acuity better than 20/200 in at least one eye, at least one eye with nonexudative disease, and age at diagnosis of 45 years or older. Persons were considered to have age-related maculopathy if one or more of the following clinical characteristics were present within a 3,000-μm radius of the fovea: drusen, retinal pigment epithelial changes, geographic atrophy, or evidence of exudative disease. Exclusion criteria based on judgments of the research staff included inability to speak English, decreased hearing or cognitive function such that the patient would be unable to understand a health status and dietary interview, and inability to return for follow-up visits.

Of 819 patients with age-related maculopathy screened for the larger study, 350 met at least one exclusion criterion. Of the remaining 469 persons eligible for enrollment, 91% (427) gave informed consent to be in the parent progression study (Seddon JM, MD, written communication, September 1998). Because the patient interviewer was available for only a portion of the days when participants were seen, 201 (47%) of the 427 participated in this ancillary quality-of-life study. It is unlikely that this introduced bias into the reported findings because the interviewer saw all participants on any given day when she was present. Because this study sample was principally assembled to identify risk factors for the progression of age-related maculopathy, persons with severe binocular disease are not represented in the baseline sample. The study protocol was approved by the institutional review board, and participants gave written informed consent before enrollment.

At the time of enrollment, patients were asked to participate in an in-person interview consisting of the Activities of Daily Vision Scale, a survey designed to assess vision-targeted functional status,[5] and the Short Form-36 (SF-36) Health Survey, a generic measure of multidimensional health-related quality of life.[35–37] Patients also reported their chronic medical conditions and current medications and provided a global rating from excellent to blind for their current habitually corrected vision.

The Activities of Daily Vision Scale consists of 21 multiple-response items representing common visual activities categorized into five subscales: night driving, daytime driving, distance vision activities that do not require driving, near vision activities, and activities subject to glare. Additionally, the subscales can be combined into an overall visual function score. All scale scores range from 0 to 100, where 100 represents no difficulty and 0 means the activities are no longer performed because of visual impairment. To increase the vision-specific quality of the Activities of Daily Vision Scale, items are structured such that if the subject indicates that an activity is difficult because of limitations not caused by vision, the item does not contribute to the scale score. Similarly, if a subject does not perform an activity, for example, driving at night, that item would not be rated for degree of difficulty. Because many persons with age-related maculopathy are older and less likely to drive, it is important to note that the reliability and validity of the Activities of Daily Vision Scale are similar when the driving items are not answered.[5]

Although originally developed to evaluate the outcome of care after cataract surgery, the Activities of Daily Vision Scale has been used successfully with populations across a range of vision problems including glaucoma and diabetic

retinopathy.[34,38,39] Because both age-related maculopathy and age-related cataract can affect central vision, we would expect reliability, validity, and sensitivity to clinically relevant changes in vision status to be similar to results previously demonstrated.[40]

The SF-36 was designed for the longitudinal assessment of the process and outcome of ambulatory medical care for chronically ill patients.[41–48] The measurement includes questions that evaluate eight dimensions of health: physical functioning, role limitations caused by physical health (role–physical), bodily pain, general health, vitality, social functioning, role limitations caused by emotional health (role–emotional), and mental health.[48] Each of the health dimensions is scored on a 0 to 100 scale, where 100 is the best possible functioning and 0 is the worst functioning. This study used a prepublication version of the SF-36 provided by the New England Medical Center Health Institute. The only difference between this study's version and the published version of the SF-36 was a six-item rather than a five-item response set for one of the two social functioning questions and "not sure" rather than "don't know" for the middle response option of the general health questions. The analyses reported here use the algorithm developed by Ware and associates[48] so that scores for our patients with age-related maculopathy could be compared with published population-based data. The SF-36 has been used for persons with a variety of ophthalmic conditions, including cataract,[34] glaucoma,[49] and diabetic retinopathy.[38] In these investigations, the reliability of the measure has been consistently high.

The developers of the SF-36 have also published a scoring algorithm that produces component mental and physical scores.[50] The component scores are designed to increase the statistical efficiency of tests by aggregating scores from items more closely related to each other to generate a smaller range of scores, thereby minimizing the variance and increasing the likelihood of detecting changes between groups. Our analyses assess the usefulness of the component SF-36 scores for capturing limitations in health-related quality of life for persons with age-related maculopathy.

At the time of study enrollment, all participants had a comprehensive dilated ophthalmologic examination after the health status interview. The examining ophthalmologist (J.M.S.) noted the presence or absence of glaucoma, cataracts, aphakia, and pseudophakia. Additionally, a refraction was performed and best-corrected visual acuity was measured in each eye by means of Early Treatment Diabetic Retinopathy Study[51] charts. The presence and severity of cataracts were graded during a slit-lamp examination by means of the Lens Opacities Classification System II reference standards.[52] Severity of cataract was also rated for each eye on an ordered scale as "not present," "mild," or "visually significant." For the purpose of adjustment in our analyses, a single binocular cataract variable was created that categorized persons along a four-point scale: none, mild in one or both eyes, visually significant in one eye, or visually significant in both eyes.

Best-corrected visual acuity in each eye was measured with Early Treatment Diabetic Retinopathy Study charts at the time of enrollment. Persons who were not able to perform visual acuity tests because of the severity of their vision loss (visual acuity worse than 20/800) were assigned the values of 20/996 for ability to count fingers, 20/997 for light perception, and 20/998 for no light perception. Visual acuity variables used in the analyses were better-eye and worse-eye acuity.

Age-related maculopathy was graded by the examining retinal specialist, who was masked to the patient's responses on the preexamination questionnaire. Both eyes were examined by means of a 90-diopter lens at the slit-lamp for evidence of punctate drusen, soft drusen, retinal pigment epithelial changes, or geographic atrophy with a 5-level scale (Appendix). Persons with these findings alone were classified as having nonexudative or "dry" age-related maculopathy (grades 2–4). Persons were classified with exudative age-related maculopathy if there was evidence of retinal pigment epithelial detachment, or choroidal neovascular membrane (grade 5). Although the enrollment criteria for the parent Age-related Macular Degeneration Progression Study excluded persons with bilateral exudative disease, a few persons had progressed to bilateral advanced disease by the time of the clinical examination for the current study. Data from both eyes were used to create a three-level severity score where age-related maculopathy was classified as "mild" if a patient only had dry changes in one or both eyes, "moderate" if they had exudative changes in at least one eye, and "severe" if they had exudative changes in both eyes. Four participants had a history of laser treatment in one eye, and one participant had laser treatment in both eyes. Because of the small number of participants who had laser treatments, we did not examine the independent effects of this treatment on reported visual functioning.

As part of the baseline procedures for the Age-related Macular Degeneration Progression Study, subjects were asked about chronic medical conditions including hypertension, diabetes mellitus, congestive heart failure, chronic obstructive lung disease, previous stroke, previous myocardial infarction, hip fracture, and malignancies other than nonmelanoma skin cancer. Patients also reported their current medication use. Presence of diabetes mellitus was verified by current use of insulin or oral hypoglycemic medication. Because it is well established that medical comorbidity can influence patients' responses on health status measures, we used an unweighted sum of all medical comorbidities to adjust for between-group differences.

To determine whether the Activities of Daily Vision Scale and SF-36 had comparable reliability when used for persons with age-related maculopathy, we calculated Cronbach coefficient α as a measure of internal consis-

tency for both the multi-item Activities of Daily Vision Scale and the SF-36 scales.[53]

The association between Activities of Daily Vision Scale and SF-36 and clinical severity of age-related maculopathy was assessed with analysis of variance models comparing unadjusted mean health status scores classified by mild, moderate, or severe age-related maculopathy. For the Activities of Daily Vision Scale overall, for each Activities of Daily Vision Scale subscale, and for each SF-36 scale, F tests for linear trend across age-related maculopathy categories were used to indicate statistical significance ($P < .05$) and strength of association. For scales with significant overall F tests, *t* tests using Tukey honestly significant difference to control for type 1 error were used to assess pairwise mean Activities of Daily Vision Scale scores by age-related maculopathy severity group.

To assess whether the observed differences in mean Activities of Daily Vision Scale subscale scores were truly attributable to age-related maculopathy, linear regression models were used to compare scores across age-related maculopathy severity groups adjusted for between-group differences in other eye conditions, age, gender, and medical comorbidities. To determine whether the influence of clinical severity of age-related maculopathy on Activities of Daily Vision Scale scores was also independent of the influence of measured visual acuity, logMAR transformed visual acuity in the better and worse eyes was then added to the linear regression models described above. The significance of the age-related maculopathy severity variable was compared in these two sets of models. To determine whether measured visual acuity was a stronger correlate of health-related quality of life than age-related maculopathy severity, we compared the partial R-square values for each predictor variable in the fully saturated models. Additionally, the overall model R-square values were compared to determine whether inclusion of visual acuity increased the proportion of variance in health status explained by vision-related characteristics.

To assess the clinical validity of the age-related maculopathy severity variable, Spearman correlation coefficients (*R*) were calculated between age-related maculopathy severity and logMAR visual acuity in the better and worse eyes, and the Activities of Daily Vision Scale and SF-36 scales.

RESULTS

THE 201 PATIENTS (63% FEMALE; 97% WHITE) HAD A MEAN ($\pm$ SD) age of 71 $\pm$ 10 years. The mean number of medical comorbidities was one, with the most common comorbid conditions being hypertension (43%), heart disease (20%), and diabetes mellitus (7%); 41% of the participants had no comorbid medical conditions.

On average, this cohort had well-preserved visual acuity, with a median corrected acuity value of 20/25 in the better eye and 20/40 in the worse eye (Table 1). Patients in this sample reported their vision as good to fair (75%), with only 8% rating their vision as poor or blind. The majority of participants had mild age-related maculopathy, defined as nonexudative changes in one or both eyes, 31% had exudative changes in at least one eye, and 5% had exudative changes in both eyes (Table 1). The distribution of specific clinical findings is displayed in Table 2. Comorbid ophthalmic conditions included 2% with visually significant cataract in at least one eye, 7% with a history of cataract extraction and intraocular lens implantation in at least one eye, and 7% with glaucoma.

TABLE 1. Clinical Severity and Chronic Eye Diseases

Corrected visual acuity, median (range)	
Better eye	20/25 (20/10–20/200)
Worse eye	20/40 (20/15–NLP)
Patient's rating of vision (no.[%])	
Excellent	33 (16%)
Good	83 (41%)
Fair	68 (34%)
Poor	16 (8%)
Blind	1 (<1%)
Severity of age-related maculopathy (no.[%])*	
Mild	128 (64%)
Moderate	62 (31%)
Severe	11 (5%)
Chronic eye diseases (no.[%])	
Visually significant cataract	
1 eye	4 (2%)
2 eyes	7 (4%)
Prior cataract extraction	
1 eye	13 (7%)
2 eyes	10 (5%)
Glaucoma, any eye	14 (7%)

NLP = no light perception.

*Eyes with evidence of drusen, retinal pigment epithelial changes, or geographic atrophy were classified as having nonexudative age-related maculopathy (grades 2–4). Eyes with evidence of retinal pigment epithelial detachment or choroidal neovascular membrane were categorized as exudative (grade 5). Persons were categorized as having "mild" age-related maculopathy if they had nonexudative changes in one or both eyes, "moderate" if they had exudative changes in at least one eye, and "severe" if they had exudative changes in both eyes.

The Cronbach coefficient α for the Activities of Daily Vision Scale averaged 0.79 over the six subscales, ranging from 0.93 (overall Activities of Daily Vision Scale score) to 0.63 (two-item disability glare scale). Alpha coefficients for the SF-36 averaged 0.86 across the eight SF-36 scales, ranging from 0.94 (role–physical functioning) to 0.62 (general health). These reliability results for both scales are comparable to published estimates from persons with other eye conditions and population-based samples.[5,48]

TABLE 2. ARM Classification Variables by Level of Severity (N = 402 eyes)

	No. (%) of Morphologic Structures		
	Mild (n = 256)	Moderate (n = 124)	Severe (n = 22)
No ARM	1 (<1)	0 (0)	0 (0)
Punctate drusen	28 (11)	4 (2)	0 (0)
RPE changes	65 (25)	11 (9)	0 (0)
Geographic atrophy	23 (9)	2 (2)	0 (0)
Soft drusen	17 (7)	5 (4)	0 (0)
Soft drusen and geographic atrophy or RPE changes	128 (48)	40 (32)	0 (0)
RPE detachment	0 (0)	9 (7)	5 (23)
CNVM	0 (0)	53 (43)	17 (77)

ARM = age-related maculopathy; CNVM = choroidal neovascular membrane; RPE = retinal pigment epithelial.

TABLE 3. Unadjusted Mean ADVS Scores by ARM Severity (N = 201)

	ARM Severity Categories*		
ADVS Scales	Mild (n = 128)†	Moderate (n = 62)‡	Severe (n = 11)§
Overall ADVS‖	80 (1.8)	77 (2.6)	62 (6.3)
Near vision‖	82 (1.9)	80 (2.7)	64 (6.5)
Distance vision	84 (1.9)	81 (2.7)	72 (6.7)
Problems with glare vision‖	77 (2.1)	77 (3.0)	58 (7.2)
Daytime driving vision‖	86 (2.6)	79 (3.9)	65 (8.7)
Nighttime driving vision	60 (3.7)	53 (5.4)	33 (15.5)

ADVS = Activities of Daily Vision Scale; ARM = age-related maculopathy.

*Data are given as mean (SEM). Punctate drusen, soft drusen, retinal pigment epithelial changes and geographic atrophy were classified as nonexudative or "dry" changes (grades 2–4). Evidence of retinal pigment epithelial detachment or choroidal neovascular membrane was classified as exudative changes (grade 5). According to this classification, persons with nonexudative changes in one or both eyes were classified as having "mild" age-related maculopathy; those with exudative changes in one eye, "moderate"; and those with exudative changes in both eyes, "severe."

†Of the 128 persons, 96 persons were driving during the day and 86 were driving at night.

‡Of the 62 persons, 44 were driving during the day and 41 were driving at night.

§Of the 11 persons with severe bilateral exudative ARM, nine persons were driving during the day and five were driving at night.

‖$P \leq .05$, F test for linear trend across ARM severity categories.

Evidence of clinical validity for the Activities of Daily Vision Scale was supported with statistically significant ($P < .05$) tests for linear trend across age-related maculopathy severity categories for four unadjusted Activities of Daily Vision Scale scores: the overall score, near vision, disability glare, and daytime driving scales (Table 3). All of these scale scores were lowest for persons with bilateral exudative changes. None of the pairwise comparisons of mean scores was statistically significant between mild and moderate levels of severity of age-related maculopathy. This suggests that, with the exception of problems with near vision and glare, persons with exudative changes in one eye only do not report substantially greater difficulty with common visual activities than persons with nonexudative age-related maculopathy in one or both eyes. However, pairwise comparisons of Activities of Daily Vision Scale scores for persons with mild vs severe age-related maculopathy were significant for the Activities of Daily Vision Scale overall, near vision, daytime driving, and glare subscales. Although those with severe age-related maculopathy had substantially lower night driving scores than persons with mild disease, these differences were not statistically significant because of the small number of persons with severe age-related maculopathy who were still driving (n = 5).

To determine whether the observed differences in mean Activities of Daily Vision Scale scores were caused by age-related maculopathy and not other participant-level characteristics, additional analyses adjusted for age, gender, medical comorbidities, and the presence of other eye diseases. These adjusted results were similar to those from the unadjusted models showing statistically significant F-test values across age-related maculopathy severity levels for the Activities of Daily Vision Scale overall score and the daytime driving, near vision, and disability glare subscales, indicating that age-related maculopathy severity is a unique and significant correlate of vision-targeted health-related quality of life. The overall R-square values for these models are shown in Table 4 as model 1.

To assess the influence of visual acuity in explaining variations in Activities of Daily Vision Scale scores, logMAR visual acuity values for the better and worse eye were added to models that included the indicator variable for age-related maculopathy clinical severity. These multivariable models were also adjusted for age, gender, medical comorbidities, and the presence of other eye conditions. Table 4 shows the overall R-square values for the multivariable models for age-related maculopathy severity (model 1) and for the same models that included better- and worse-eye visual acuity (model 2). These models show that visual acuity is a much stronger correlate of vision-targeted health-related quality of life, explaining why there was three times as much variation in Activities of Daily Vision Scale scores. The individual partial F test results for these models found visual acuity in the better

TABLE 4. Regression Results for Activities of Daily Vision Scale Models With and Without Visual Acuity*

	Model 1 R-square	Model 2 R-square
Overall score	0.14	0.40
Night driving	0.10	0.42
Day driving	0.10	0.39
Near vision	0.13	0.37
Distance vision	0.12	0.29
Glare problems	0.08	0.23

*Model 1 includes adjustments for clinical severity of age-related maculopathy, age, gender, medical comorbidities, and presence of other eye conditions. Model 2 includes the same adjustments as model 1 but also includes logMAR visual acuity values for the better and worse eye.

TABLE 5. Unadjusted SF-36 Scores by ARM Severity (N = 201)*

	ARM Severity Categories†		
SF-36 Scales	Mild (n = 128)	Moderate (n = 62)	Severe (n = 11)
Physical functioning	79 (2.2)	80 (3.2)	79 (7.5)
Role–physical	67 (3.7)	76 (5.3)	77 (12.6)
Bodily pain	73 (2.2)	75 (3.1)	82 (7.4)
General health	68 (1.5)	68 (2.2)	63 (5.3)
Vitality	61 (2.0)	59 (2.8)	66 (6.7)
Social functioning	92 (1.6)	92 (2.2)	99 (5.3)
Role–emotional	82 (3.1)	87 (4.4)	88 (10.5)
Mental health	75 (1.7)	74 (2.5)	73 (5.9)
Component score, physical‡	−0.35 (0.09)	−0.23 (0.14)	−0.19 (0.32)
Component score, mental‡	−0.22 (0.09)	0.18 (0.13)	0.32 (0.30)

ARM = age-related maculopathy.

*None of the SF-36 subscales was significant for linear trend across groups.

†Data are given as mean (SEM). Eyes with evidence of drusen, retinal pigment epithelial changes, or geographic atrophy were classified as having nonexudative ARM (grades 2–4). Eyes with evidence of retinal pigment epithelial detachment or choroidal neovascular membrane were categorized as exudative (grade 5). Persons were categorized as having "mild" ARM if they had nonexudative changes in one or both eyes, "moderate" if they had exudative changes in at least one eye, and "severe" if they had exudative changes in both eyes.

‡The physical and mental SF-36 component scores are derived from normalized population values, where the mean is 0 and the SD is 1.

eye to be significant ($P < .05$) across all five Activities of Daily Vision Scale subscales and the overall score and contributes the largest portion of predicted variance (not shown) across all Activities of Daily Vision Scale scales in each of the model 2 results. In the fully saturated models, the age-related maculopathy severity variable was nonsignificant (partial F, $P > .05$) across all six subscales of the Activities of Daily Vision Scale, including the four subscales that had previously been significant when visual acuity was not in the models. Visual acuity in the worse eye was significant (partial F, $P < .02$) for the Activities of Daily Vision Scale overall score, night driving, and near vision subscales. These results illustrate the importance of visual acuity as an explanatory variable for predicting visual functional status for patients with age-related maculopathy.

The tests of clinical validity comparing unadjusted mean SF-36 scale scores across age-related maculopathy severity groups were nonsignificant for all eight scales (Table 5). Similarly, the component physical health and mental health scores were also nonsignificant for linear trend across the age-related maculopathy severity categories. Because the scores overall were nonsignificant, no pairwise comparisons between groups were made.

Spearman correlation coefficient R between the age-related maculopathy clinical severity variable and the Activities of Daily Vision Scale and SF-36 scales, respectively, was nonsignificant ($P < .05$) for all comparisons (Table 6). Correlations between age-related maculopathy severity and the Activities of Daily Vision Scale subscales ranged from −0.03 (glare scale) to −0.18 (daytime driving). For the SF-36 scales, correlations between age-related maculopathy severity were similarly low, ranging from −0.03 (mental health and general health) to 0.12 (role–physical). Similarly, the two SF-36 component scales showed low correlations with age-related maculopathy severities of 0.05 (physical functioning) and 0.01 (mental health). Visual acuity in the better eye was significantly correlated with all six Activities of Daily Vision Scale scores, ranging from −0.31 (glare scale) to −0.51 (night driving), although correlations with all SF-36 scales were nonsignificant ($P > .05$). Visual acuity in the worse eye was significantly correlated with five of the six Activities of Daily Vision Scale scales, with only the disability glare scale being nonsignificant. Worse-eye visual acuity was the only clinical variable to show a significant ($P < .05$) correlation with an SF-36 scale (−0.27, physical functioning). Self-reported verbal rating of binocular vision (not shown) was significantly correlated with severity of age-related maculopathy ($R = -0.18$), better-eye visual acuity ($R = -0.51$), and worse-eye acuity ($R = -0.45$).

DISCUSSION

OUR RESULTS ILLUSTRATE THE PERFORMANCE OF GENERIC health-related quality of life and vision-targeted measures for a sample of patients with age-related maculopathy and the

TABLE 6. Spearman Correlations of ADVS and SF-36 Scores With ARM Severity and Visual Acuity (N = 201)*

		Visual Acuity	
	ARM Severity	Better Eye	Worse Eye
ADVS			
Overall score	−0.15	−0.47†	−0.42†
Night driving (n = 132)	−0.13	−0.51†	−0.51†
Daylight driving (n = 149)	−0.18	−0.45†	−0.39†
Near vision	−0.13	−0.46†	−0.39†
Far vision	−0.11	−0.37†	−0.30†
Glare problems	−0.03	−0.31†	−0.20
SF-36			
Physical functioning	−0.01	−0.18	−0.27†
Role–physical	0.12	−0.14	−0.13
Bodily pain	0.09	0.01	0.02
General health	−0.03	−0.15	−0.15
Vitality	−0.01	−0.10	−0.15
Social functioning	0.04	−0.07	−0.08
Role–emotional	0.07	0.02	−0.03
Mental health	−0.03	−0.09	−0.08
Component score, physical	0.05	−0.10	−0.16
Component score, mental	0.01	0.02	−0.05

ADVS = Activities of Daily Vision Scale; ARM = age-related maculopathy.

*Eyes with evidence of drusen, retinal pigment epithelial changes, or geographic atrophy were classified as having nonexudative ARM (grades 2–4). Eyes with evidence of retinal pigment epithelial detachment or choroidal neovascular membrane were categorized as exudative (grade 5). Persons were categorized as having "mild" ARM if they had nonexudative changes in one or both eyes, "moderate" if they had exudative changes in at least one eye, and "severe" if they had exudative changes in both eyes.

†$P < .05$, adjusted for multiple comparisons.

relationship of these measures with standard clinical indicators of severity of age-related maculopathy. The SF-36 had low and nonsignificant correlations with both clinical indicators of age-related maculopathy severity and visual acuity. Similarly, unadjusted mean SF-36 scores were nonsignificant across severity categories of age-related maculopathy.

The vision-specific Activities of Daily Vision Scale showed much greater sensitivity for detecting differences within the sample when stratified by morphologic severity. However, in models that adjusted for visual acuity, clinical severity was not an independent correlate of reported difficulty with common visual tasks. Visual acuity increased the predicted variance by approximately threefold for models that included age-related maculopathy severity. It is likely that our measure of clinical severity had less precision than visual acuity because it is an ordinal 3 level variable. Our findings suggest that self-reported measures of visual functioning such as the Activities of Daily Vision Scale can augment clinical data and may be useful to compare and longitudinally follow up persons with age-related maculopathy. The weak association between age-related maculopathy severity and the SF-36 scores suggests that this generic measure of health-related quality of life may not be as useful a tool for capturing vision-specific disabilities related to age-related maculopathy. It is important to note that, on average, the patients in this sample had well-preserved vision in at least one eye, which may account for the lack of association.

Our finding that visual acuity more accurately represents self-reported impairments in visual functioning from age-related maculopathy than observed clinical severity must be considered in relation to the spectrum of disease severity represented in this sample. Also, because the Activities of Daily Vision Scale itself is concerned exclusively with measuring specific activities related to vision, it lends itself to capturing impairments related to visual acuity. It is possible that a health-related quality of life measure that includes emotional or psychological dimensions of vision-related health might detect effects from age-related maculopathy that are unique from visual acuity. At the same time, the predicted variance for the fully saturated models (model 2) shown in Table 4 never exceeded 0.42 (night driving), indicating that a good portion of self-reported vision-targeted activities was not explained by visual acuity or age-related maculopathy severity or any of the other demographic and clinical variables included in these models.

This investigation had a number of important limitations. Because the study sample was principally assembled to identify risk factors for the progression of age-related maculopathy, persons with severe binocular disease are not represented in the baseline sample. The mild levels of maculopathy in this sample mean that generalizations from our findings are limited in regard to the general population of patients with age-related maculopathy. Also, the study was performed at a single tertiary care specialty hospital and therefore may not represent the typical patients who are seen in community-based clinic settings. However, it is unlikely that the correlations between clinical indicators of age-related maculopathy severity, such as visual acuity and health status, would have been different in other populations with similar levels of age-related maculopathy. Additionally, there were few participants with binocular exudative disease, by design of the parent Age-related Macular Degeneration Progression Study. It is possible that persons with severe binocular disease may have had poorer SF-36 scores.

To date, much work has examined the influence of age-related cataract and self-reported visual functioning and the influence of visual field loss on both vision-targeted and generic measures of health-related quality of life.[39,49,54] However, most studies involving eye diseases other than cataract and glaucoma have used questions designed to evaluate the functional impact of a narrowly defined condition or treatment, typically derived from

specific symptoms associated with the condition of interest. For these studies, descriptions of visual disability or functional difficulties attributed to vision are limited to reports of visual function after enucleation for ocular melanoma[55–57] or visual limitations after laser treatments for diabetic retinopathy,[58] or have emphasized specific tasks such as face recognition in maculopathy and other retinal disorders.[2–4] Although more research has yet to be conducted on patient-reported health-related quality of life, evidence from research on patients with other conditions supports the inclusion of these measures into studies of age-related maculopathy.

Age-related maculopathy rarely occurs in isolation and therefore is a chronic condition that contributes to the cumulative effects of many of the chronic medical conditions that are associated with aging, such as congestive heart failure and diabetes mellitus. A better understanding of the positive impact of vision-preserving therapies on health-related quality of life and, specifically, a patient's capacity for independent living may preserve resource allocation for therapies designed to arrest or treat age-related maculopathy. Finally, self-reported visual functioning and health-related quality of life data permit comparisons across vision-specific and other medical conditions and technologies. These comparisons and the cumulative knowledge of health status will help to establish the relative burden of different conditions and the relative merits of interventions on a comparable metric.

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APPENDIX. Classification of Age-Related Maculopathy

1. No drusen or small nonextensive drusen, without pigment abnormalities
2. Extensive small (hard) drusen or nonextensive intermediate drusen, or pigment abnormalities associated with age-related maculopathy
3. Extensive intermediate drusen or any large (soft) drusen
4. Geographic atrophy with involvement of the center of the macula*; or if not involving the center, must be at least 325 μm
5. Exudative age-related maculopathy, including nondrusenoid pigment epithelial detachments, serous or hemorrhagic retinal detachments, subretinal or subretinal pigment epithelial hemorrhage or fibrosis, or photocoagulation scars consistent with treatment of age-related maculopathy

*Macula is defined by a circle centered on the fovea with a radius of 3,000 μm.

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