Age-Related Eye Disease, Quality of Life, and Functional Activity

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Objective: To examine the associations of measures of quality of life (Medical Outcomes Study Short Form Health Survey) and functional activities (activities of daily living, instrumental activities of daily living, and visual function) in persons with and without age-related eye diseases.

Methods: Two thousand, six hundred seventy persons participated in the 1998 through 2000 examinations of both the Beaver Dam Eye Study and the Epidemiology of Hearing Loss Study. Age-related eye disease (age-related maculopathy, cataract, diabetic retinopathy, glaucoma, macular edema, occlusions, amblyopia, and macular holes) were assessed by fundus, slitlamp, and retroilluminated photographs and self-reported ocular history. Also administered was a standard interview that included the Medical Outcomes Study Short Form Health Survey, activities of daily living, instrumental activities of daily living, and visual function questionnaires and information on other medical conditions.

Results: After controlling for age and sex, we found that persons with an age-related eye disease had decreased scores in almost all the domains of the Medical Outcomes Study Short Form Health Survey, and persons with eye disease in both eyes had poorer scores than persons with eye disease in only 1 eye. Stratifying by age-related maculopathy and central cataract yielded similar results. Further adjustment for current visual acuity and the number of comorbid conditions explained most associations. Several of the mental scales were still marginally significantly lower (P<.10) in persons with age-related maculopathy after adjustment. Persons with an age-related eye disease were not more likely to have impaired activities of daily living or instrumental activities of daily living. After adjustment for current visual acuity and number of comorbidities, persons who had trouble reading small print or recognizing people across the street were more likely to have an age-related eye disease. Otherwise, there were no significant associations with the visual function questions and any of the specific ocular conditions.

Conclusions: Many measures of general quality of life and functional activities were related to age-related eye diseases, but few associations remained significant after adjustments for vision and other comorbidities. Our data are compatible with the notion that decreased visual function, irrespective of the pathologic reason for the decrease, is associated with diminished quality of life and functional activities of living.


The personal impact of disease, in general, is its implications for impaired function. For some diseases, the functional impairment is directly related to the body part affected, such as an amputation where a lower extremity is affected by trauma or vascular occlusion. However, some sensory illnesses have far-reaching effects on function. Ocular problems, due to a variety of eye diseases, have been suggested as playing a role in decreased self-assessed visual function and on other general activities of living independently. While many researchers are interested in the pathology of the specific eye diseases and strategies to prevent them, the functional impact is often of most concern to patients. Diminished vision has economic and psychological impact on people's lives. Further, certain eye diseases have been shown to be associated with declines in quality-of-life measures independent of vision. Thus, in addition to age itself, certain eye diseases are among the most feared chronic disabilities among the US public. In the current report, we assess quality of life, as measured by the Medical Outcomes Study Short Form Health Survey (SF-36), activities of daily living (ADL), and a visual function (VF)
questionnaire in persons with and without age-related eye diseases in a large Midwestern population-based cohort study.

**METHODS**

**PARTICIPANTS**

Study subjects included persons participating in both the Beaver Dam Eye Study (BDES) and the Epidemiology of Hearing Loss Study (EHLs) during the 1998-2000 examination phase (N=2670). Detailed descriptions of the design of both studies appear in other reports. A private census was conducted in the city and township of Beaver Dam, Wisconsin, in 1987 and 1988 to identify and recruit subjects for the BDES. Of the 5924 eligible persons, 4926 (83%) participated in the baseline examination, with ages ranging from 43 to 86 years. The EHLs began at the 5-year follow-up examination of the BDES. The data for the current study were collected from 1998-2000 at the 10-year follow-up examination of the BDES and the 5-year follow-up of the EHLs, when the questionnaire concerned quality of life and activity levels were first administered to the entire cohort. Twenty-five percent of the population completed both studies on the same day, and over 95% of the cohort completed both studies within 5 months of each other. Differences between participants and nonparticipants at examinations have been presented for both the BDES and the EHLs. In general, live nonparticipants in 1 or both studies were older and sicker than persons who completed both studies. All data were collected with institutional review board approval in conformity with all federal and state laws, and the study was in adherence to the tenets of the Declaration of Helsinki.

**QUALITY OF LIFE**

Health-related quality of life was ascertained using the SF-36. The SF-36 assessed function, sense of well-being, disability, and personal evaluation of both physical and mental health. The individual questions were grouped into 8 subscales to measure the following health domains: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health. The scores calculated for each domain ranged from 0 to 100, with higher scores indicating fewer limitations or disabilities. The 8 scores were also summarized into a mental component score and a physical component score, which have been shown to be accurate summary measures of the 8 subscales. All scores were calculated according to the recommended guidelines and algorithms.

**FUNCTIONAL ACTIVITIES**

Information on ADL and instrumental activities of daily living (IADL) was collected. The ADL portion included 7 questions about activities, such as walking across a small room, bathing, and using a toilet. The IADL portion included 12 questions about activities, such as preparing meals, using a telephone, and doing laundry. More detailed information on these questionnaires is contained in other reports.

We also administered a VF questionnaire, which included questions about vision limited the participants in (1) reading small print as found in the telephone book or the classified ads, (2) reading regular print as found in newspapers, magazines, recipes, menus, or numbers on the telephone, (3) reading road signs or counting pins at the end of a bowling alley, and (4) recognizing people or objects across the street. Possible answers to these questions were none, little, some, most, all, or do not know. Participants were further asked whether they drove at night and, if so, how much they were limited by their vision. If participants did not drive at night, they were asked whether it was because of their vision. Participants were also asked to rate their best-corrected vision as excellent, very good, good, fair, or poor.

**EYE DISEASE AND VISUAL ACUITY DEFINITIONS**

The presence of age-related maculopathy (ARM), diabetic retinopathy, and other retinal conditions were evaluated from stereoscopic 30° color fundus photographs centered on the disc (Diabetic Retinopathy Study standard field 1) and macula (Diabetic Retinopathy Study standard field 2) and a nonstereoscopic color fundus photograph temporal to but including the fovea. Grading of ARM was performed in a masked fashion using a standardized protocol, the Wisconsin Age-Related Maculopathy Grading scheme described elsewhere. For purposes of this article, an eye was considered to have ARM if soft indistinct drusen or any drusen plus pigmentary abnormalities (increased retinal pigment or retinal pigment epithelial depigmentation) or signs of late-stage ARM (exudative ARM or geographic atrophy) were present within an area of a circle with a radius of 3000 µm centered on the fovea. There were not enough persons with late ARM who were free of other eye disease (eg, cataract) to evaluate those with late ARM as a separate group (18 persons with unilateral and 16 persons with bilateral late ARM). Exclusion of these persons did not significantly alter results.

Slitlamp and retroilluminated photographs of the lens were taken with specifically modified cameras to evaluate presence and type of cataract. Procedures for grading cataract (lens opacities) appear elsewhere. An eye was defined as having any cataract if cortical cataract covered more than 5% of the lens surface, nuclear sclerotic cataract was graded as level 4 or 5 on a 5-step scale, or posterior subcapsular cataract covered more than 5% of any subfield of the lens measurement grid. Central cataract was defined as the presence of a nuclear sclerotic cataract or a posterior subcapsular cataract or cortical cataract involving 25% or more of the central circle of the lens measurement grid. People who underwent cataract surgery were not included in the cataract analysis.

During the eye examination and subsequent grading of photographs, a variety of other eye conditions were assessed, including central or branch artery/vein occlusions, macular edema, diabetic retinopathy, glaucoma (defined as taking glaucoma drops or a self-reported history of glaucoma), amblyopia (lazy eye), trauma, and congenital diseases. The number of persons in each of these subgroups was too small to analyze separately.

Visual acuity was assessed in 2 ways. First, before refraction, the participants were first asked to read the Early Treatment of Diabetic Retinopathy Study chart R, modified for a 2-m distance, with their current prescription using both eyes. The number of letters correctly read was recorded. On average, 40 letters represent a Snellen equivalent of 20/40 and 55 letters a Snellen equivalent of 20/20. Refraction was performed and best-corrected visual acuity was then measured for each eye using a modification of the Early Treatment of Diabetic Retinopathy Study protocol.

**OTHER VARIABLES**

Age was defined as the participant's age at the time of the 1998-2000 eye exam. During the eye examination, participants were asked whether they had a history of any of the following conditions: cardiovascular disease (angina, myocardial infarc-
cosylated hemoglobin and a random blood glucose cal history of diabetes mellitus in the presence of elevated glycations. Diabetes mellitus was defined as a history of diabetes or equal to 140 mm Hg or diastolic blood pressure greater than sys-
tension status was defined as systolic blood pressure greater than
number of similar conditions.

Scores. Squaring the scores on their original scale yielded Box-
the right (ie, higher scores were more likely to occur than lower
mental health scales were relatively continuous but skewed to
ation, general health, mental component score, vitality, and
SF-36 questionnaire, the physical component score, physical func-
tional activity (ADL, IADL, and VF) measures in these per-
years, 75 to 84 years, and 85 or more years.

P
values are for trend in regression models for continuous risk factors and Cochran-Mantel-Haenszel trend tests for categorical variables adjusted for age in
groups (53-64 years, 65-74 years, 75-84 years, and 85 + years).

Best-corrected visual acuity in the better eye, No. of letters 53.9 53.0 49.5 .49
Diabetes, % 12.0 10.7 16.9 .49
Systolic blood pressure, mm Hg 131.2 133.3 135.0 .001
Mean comorbidities, No. 1.7 1.8 1.9 .07
Age, y 64.4 70.4 75.7 NA
Men, % 43.1 44.1 39.7 .30
Education, y 12.5 12.2 11.9 .001
Systolic blood pressure, mm Hg 131.2 133.3 135.0 .001
Diastolic blood pressure, mm Hg 72.0 72.3 72.4 .83
Hypertensive, % 57.0 62.4 61.6 .02
History of cardiovascular disease, % 18.7 18.8 18.3 .96
Current prescription visual acuity, No. of letters 53.0 52.0 49.1 .001

P
Abbreviation: NA, not applicable.

*Eye diseases considered included central cataract, age-related maculopathy, diabetic retinopathy, glaucoma, macula edema, occlusions, ambylopia, and macular holes (persons with a visual acuity of 20/40 or worse and none of these conditions not included; n = 159).
†Means and percentages adjusted for age in groups (53-64 years, 65-74 years, 75-84 years, and 85 + years).
‡P
\textsuperscript{*}Values are for trend in regression models for continuous risk factors and Cochran-Mantel-Haenszel trend tests for categorical variables adjusted for age in
groups (53-64 years, 65-74 years, 75-84 years, and 85 + years).

Cox normalizing transformations.\textsuperscript{27} Using the transformed vari-
ables as the dependent variable, we performed simple linear re-
gression. The other scales (role-physical, bodily pain, social
functioning, and role-emotional) were more discrete in nature
and did not lend themselves to normalizing transformations.
Therefore, we categorized these variables into 3 levels and per-
formed ordinal logistic regression.\textsuperscript{28} For ease of interpretation,
results are reported in the original untransformed scale, but the
\( P \) values are from the previously described models.

To assess differences in quality of life (SF-36) and
functionality (ADL, IADL, and VF) measures in these per-
sons. Different statistical models were used with each quality-
of-life outcome because their distributions differed. From the
SF-36 questionnaire, the physical component score, physical func-
tioning, general health, mental component score, vitality, and
mental health scales were relatively continuous but skewed to
the right (ie, higher scores were more likely to occur than lower
scores). Squaring the scores on their original scale yielded Box-

**Table 1. Age-Adjusted Demographic and Medical Characteristics of the Population by Number of Eyes Affected by Disease**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No Eyes Affected (n = 1444), Mean or %†</th>
<th>1 Eye Affected (n = 426), Mean or %†</th>
<th>Both Eyes Affected (n = 641), Mean or %†</th>
<th>( P ) Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>64.4</td>
<td>70.4</td>
<td>75.7</td>
<td>NA</td>
</tr>
<tr>
<td>Men, %</td>
<td>43.1</td>
<td>44.1</td>
<td>39.7</td>
<td>.30</td>
</tr>
<tr>
<td>Best-corrected visual acuity in the better eye, No. of letters</td>
<td>53.9</td>
<td>53.0</td>
<td>49.5</td>
<td>.49</td>
</tr>
<tr>
<td>Current prescription visual acuity, No. of letters</td>
<td>53.0</td>
<td>52.0</td>
<td>49.1</td>
<td>.49</td>
</tr>
<tr>
<td>Education, y</td>
<td>12.5</td>
<td>12.2</td>
<td>11.9</td>
<td>.001</td>
</tr>
<tr>
<td>Systolic blood pressure, mm Hg</td>
<td>131.2</td>
<td>133.3</td>
<td>135.0</td>
<td>.001</td>
</tr>
<tr>
<td>Hypertensive, %</td>
<td>57.0</td>
<td>62.4</td>
<td>61.6</td>
<td>.02</td>
</tr>
<tr>
<td>History of cardiovascular disease, %</td>
<td>18.7</td>
<td>18.8</td>
<td>18.3</td>
<td>.96</td>
</tr>
<tr>
<td>Diabetes, %</td>
<td>12.0</td>
<td>10.7</td>
<td>16.9</td>
<td>.49</td>
</tr>
<tr>
<td>Mean comorbidities, No.</td>
<td>1.7</td>
<td>1.8</td>
<td>1.9</td>
<td>.07</td>
</tr>
</tbody>
</table>

**STATISTICAL ANALYSIS**

All statistical analyses were performed using version 8.1 of SAS.\textsuperscript{26} We first performed analyses comparing various demographic and medical conditions among persons with no eye disease, persons with unilateral disease, and persons with bilateral disease (Table 1). Any eye disease was defined as present if the eye had 1 or more of the following conditions: central cataract, ARM, diabetic retinopathy, glaucoma, macula edema, central or branch artery/vein occlusion, ambylopia, or macular holes. Signifi-
cance between groups was assessed by linear regression for con-
tinuous variables (eg, blood pressure) and Mantel-Haenszel pro-
cedures for categorical variables (eg, sex). Means and percentages were adjusted for age using 4 groups: 53 to 64 years, 65 to 74 years, 75 to 84 years, and 85 or more years.

We next assessed differences in quality of life (SF-36) and functional activity (ADL, IADL, and VF) measures in these per-
sons. Different statistical models were used with each quality-
of-life outcome because their distributions differed. From the
SF-36 questionnaire, the physical component score, physical func-
tioning, general health, mental component score, vitality, and
mental health scales were relatively continuous but skewed to
the right (ie, higher scores were more likely to occur than lower
scores). Squaring the scores on their original scale yielded Box-


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RESULTS

Table 1 presents characteristics of the population by having an age-related eye disease in neither, 1, or both eyes. Persons with an eye disease were older (P < .001). Further, persons with an eye disease in both eyes were older than persons with an eye disease in only 1 eye. After we adjusted for age, there was no difference by sex (P = .30). After we adjusted for age, persons with an eye disease in 1 or both eyes had higher mean systolic blood pressure, were more likely hypertensive, had poorer vision, and were less educated than persons without an eye disease. There was no difference in mean diastolic blood pressure, number of comorbid conditions, having a history of cardiovascular disease, or diabetes status. Results were largely similar when restricting to specific eye conditions (results not shown).

Table 2 shows the SF-36 scales by age-related eye disease status. Table 3 shows the ADL, IADL, and VF questions by age-related eye disease status. After we adjusted for age and sex, all scores from the SF-36 scales, except bodily pain and role-emotional, were significantly lower.
in persons with an age-related eye disease (Table 2). Scores for 2 scales (role-physical and mental health) remained significant ($P < .05$) after further adjustment for current visual acuity and number of comorbid conditions. Scores for 4 of the scales (general health, mental component score, vitality, and social functioning) remained marginally significant ($P < .10$). In scales where a difference was found, persons with an age-related eye disease in both eyes had consistently lower scores than persons with an age-related eye disease in only 1 eye. After multivariate adjustment, persons with an age-related eye disease were more likely to be impaired in ADL, grooming oneself, general vision, reading newspaper print, recognizing people across the street, and reading small print (Table 3). Also, persons with an age-related eye disease were less likely to state they were as healthy as others.

We next stratified the data into subgroups of ARM (Table 4 and Table 5) and central cataract (Table 6 and Table 7), excluding persons with multiple ocular conditions. After we adjusted for age and sex, all SF-36 scale scores were significantly lower in persons with ARM, and in addition, persons with bilateral disease had poorer scores than persons with unilateral disease. Scores for 4 scales (bodily pain, mental component score, vitality, and social functioning) remained significant after multivariate adjustment (Table 4). After we adjusted for age and sex, the VF measures were more likely impaired in persons with ARM, but no associations remained significant after further adjustment for current visual acuity and number of comorbid conditions (Table 5). Persons with central cataract had significantly lower scores, after we adjusted for age and sex, in 5 scales (physical component score, physical functioning, role-physical, mental component score, and mental health; Table 6). None of these relationships remained significant after further adjustment. Persons with central cataract were more likely to state they were not as healthy as other persons than persons without central cataract (Table 7). Results were largely similar using a broader definition of any cataract (results not shown).

### Table 4. Medical Outcomes Study Short Form Health Survey Scales by Age-Related Maculopathy in Neither, 1, or Both Eyes*

<table>
<thead>
<tr>
<th>Measure†</th>
<th>Neither Eye Affected (n = 1356)</th>
<th>1 Eye Affected (n = 195)</th>
<th>Both Eyes Affected (n = 179)</th>
<th>P Value</th>
<th>Age-Sex</th>
<th>Multivariate Adjusted‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD Median</td>
<td>Mean ± SD Median</td>
<td>Mean ± SD Median</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical component score</td>
<td>47 ± 9.3 50</td>
<td>46 ± 10.6 49</td>
<td>41 ± 11.9 44</td>
<td>.006</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td>Physical functioning</td>
<td>79 ± 21.4 85</td>
<td>74 ± 24.8 85</td>
<td>64 ± 28.0 70</td>
<td>.007</td>
<td>1.11</td>
<td></td>
</tr>
<tr>
<td>Role-physical</td>
<td>83 ± 32.0 100</td>
<td>77 ± 34.9 100</td>
<td>62 ± 41.7 75</td>
<td>.02</td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td>Bodily pain</td>
<td>74 ± 22.5 74</td>
<td>71 ± 23.3 72</td>
<td>64 ± 26.7 62</td>
<td>.007</td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>74 ± 18.1 77</td>
<td>72 ± 18.1 77</td>
<td>64 ± 21.3 67</td>
<td>.02</td>
<td>.19</td>
<td></td>
</tr>
<tr>
<td>Mental component score</td>
<td>56 ± 7.0 57</td>
<td>55 ± 7.9 58</td>
<td>53 ± 8.6 55</td>
<td>.009</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Vitality</td>
<td>66 ± 18.5 70</td>
<td>63 ± 20.0 65</td>
<td>56 ± 21.0 55</td>
<td>.002</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Social functioning</td>
<td>91 ± 16.6 100</td>
<td>89 ± 18.5 100</td>
<td>82 ± 21.4 88</td>
<td>.003</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Role-emotional</td>
<td>94 ± 20.0 100</td>
<td>92 ± 23.5 100</td>
<td>82 ± 33.9 100</td>
<td>.05</td>
<td>.24</td>
<td></td>
</tr>
<tr>
<td>Mental health</td>
<td>82 ± 13.9 84</td>
<td>81 ± 15.1 84</td>
<td>77 ± 16.6 80</td>
<td>.01</td>
<td>.08</td>
<td></td>
</tr>
</tbody>
</table>

*Numbers vary by up to 20 persons because of missing information.
†Outcomes were evaluated using different statistical models (see the “Methods” section for details).
‡Adjusted for age, sex, number of comorbid conditions, and current visual acuity (number of letters).

### Table 5. Percent Impaired by Age-Related Maculopathy in Neither, 1, or Both Eyes for the Activities of Daily Living, Instrumental Activities of Daily Living, and Visual Function Questions*

<table>
<thead>
<tr>
<th>Outcome†</th>
<th>Neither Eye Affected (n = 1379), %</th>
<th>1 Eye Affected (n = 199), %</th>
<th>Both Eyes Affected (n = 183), %</th>
<th>P Value</th>
<th>Age-Sex</th>
<th>Multivariate Adjusted‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impaired activities of daily living</td>
<td>8.8 10.7 24.9</td>
<td>.20 43</td>
<td>.63</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired instrumental activities of daily living</td>
<td>36.4 39.3 56.7</td>
<td>.08 44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired personal grooming</td>
<td>1.3 2.0 3.3</td>
<td>.85 70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not feel as healthy as others</td>
<td>10.2 11.8 21.2</td>
<td>.03 23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health predicted to worsen</td>
<td>20.8 20.5 28.1</td>
<td>.35 42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired general vision</td>
<td>0.4 0.5 8.2</td>
<td>&lt;.001 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired night driving</td>
<td>24.8 24.2 45.0</td>
<td>.05 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired reading newsprint</td>
<td>11.6 14.6 29.5</td>
<td>.002 17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired reading road signs</td>
<td>8.4 5.0 21.5</td>
<td>&lt;.001 0.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired recognizing people across the street</td>
<td>13.1 14.6 30.6</td>
<td>.01 38</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired reading small print</td>
<td>26.6 28.8 45.1</td>
<td>.000 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Numbers vary by up to 27 persons because of missing information.
†Outcomes were dichotomized and analyzed with logistic regression (see the “Methods” section for details).
‡Adjusted for age, sex, number of comorbid conditions, and current visual acuity (number of letters).
In this study, we found that persons with an age-related eye disease had decreased quality of life as measured by the SF-36, ADL, and IADL instruments and a VF questionnaire. This study extends the findings from our investigation in 1993 of quality of well-being and self-reported ocular and other medical conditions.29 In our previous investigation, we found persons with self-reported cataract or macular degeneration generally had lower quality-of-life measures than persons free of the condition. However, at the time of that study, we did not have a measurement of visual function or ocular photographs to confirm self-reported diagnosis. Our current study adds the advantages of having ocular photographs and measurement of visual acuity. After adjusting for vision and comorbidities and using the more reliable definitions of eye disease, we found few significant associations between quality-of-life measures and age-related eye disease.

It is common practice in ophthalmology to infer the impact of vision on quality of life based on measurements in the clinic of visual acuity, near vision, or contrast sensitivity. However, these measures may not provide information on day-to-day functions requiring vision, such as reading, driving, and performing specific tasks.30 In this study, we evaluated quality-of-life and functional abilities both in a broad sense (SF-36, ADL, and IADL) and in a narrow sense (VF questions). Visual function questions (eg, National Eye Institute Visual Function Questionnaire 25) have been shown to be more sensitive than the other generic scales at assessing vision-related quality of life but do not give an overall sense of health-related quality of life.31,32

We chose to present analyses adjusted for current binocular visual acuity because this was thought to best represent their ambient vision. Rubin and collaborators33 have shown that other psychophysical measures of visual impairment (eg, contrast sensitivity) are just as related to quality of life as visual acuity. There was not a change to

### Table 6. Medical Outcomes Study Short Form Health Survey Scores by Central Cataract in Neither, 1, or Both Eyes*

<table>
<thead>
<tr>
<th>Measure†</th>
<th>Neither Eye Affected (n = 1197)</th>
<th>1 Eye Affected (n = 126)</th>
<th>Both Eyes Affected (n = 142)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical component score</td>
<td>48 ± 8.9 51</td>
<td>47 ± 9.8 49</td>
<td>43 ± 10.8 45</td>
<td>.05 .11</td>
</tr>
<tr>
<td>Physical functioning</td>
<td>81 ± 20.2 90</td>
<td>76 ± 23.6 85</td>
<td>67 ± 26.7 75</td>
<td>.02 .07</td>
</tr>
<tr>
<td>Role-physical</td>
<td>85 ± 30.4 100</td>
<td>76 ± 35.5 100</td>
<td>69 ± 39.9 100</td>
<td>.04 .40</td>
</tr>
<tr>
<td>Bodily pain</td>
<td>75 ± 21.8 74</td>
<td>74 ± 21.8 72</td>
<td>72 ± 25.9 74</td>
<td>.84 .45</td>
</tr>
<tr>
<td>General health</td>
<td>75 ± 17.6 77</td>
<td>71 ± 19.5 77</td>
<td>69 ± 19.9 72</td>
<td>.18 .74</td>
</tr>
<tr>
<td>Mental component score</td>
<td>56 ± 6.7 57</td>
<td>54 ± 7.7 56</td>
<td>55 ± 8.4 57</td>
<td>.03 .06</td>
</tr>
<tr>
<td>Vitality</td>
<td>67 ± 18.2 70</td>
<td>63 ± 21.6 70</td>
<td>61 ± 22.0 60</td>
<td>.54 .99</td>
</tr>
<tr>
<td>Social functioning</td>
<td>92 ± 15.6 100</td>
<td>89 ± 18.2 100</td>
<td>85 ± 21.2 100</td>
<td>.10 .32</td>
</tr>
<tr>
<td>Role-emotional</td>
<td>95 ± 18.0 100</td>
<td>91 ± 23.3 100</td>
<td>90 ± 25.9 100</td>
<td>.20 .29</td>
</tr>
<tr>
<td>Mental health</td>
<td>83 ± 13.6 88</td>
<td>79 ± 16.8 84</td>
<td>80 ± 17.1 84</td>
<td>.03 .11</td>
</tr>
</tbody>
</table>

*Numbers vary by up to 2 persons because of missing information.
†Outcomes were evaluated using different statistical models (see the “Methods” section for details).
‡Adjusted for age, sex, number of comorbid conditions, and current visual acuity (number of letters).

### Table 7. Percent Impaired by Central Cataract in Neither, 1, or Both Eyes for the Activities of Daily Living, Instrumental Activities of Daily Living, and Visual Function Questions*

<table>
<thead>
<tr>
<th>Outcome†</th>
<th>Neither Eye Affected (n = 1213), %</th>
<th>1 Eye Affected (n = 127), %</th>
<th>Both Eyes Affected (n = 145), %</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impaired activities of daily living</td>
<td>6.9 9</td>
<td>9.4 9</td>
<td>14.0 14</td>
<td>.93 .60</td>
</tr>
<tr>
<td>Impaired instrumental activities of daily living</td>
<td>33.6 39.4</td>
<td>48.6 48.6</td>
<td>.57 .64</td>
<td></td>
</tr>
<tr>
<td>Impaired personal grooming</td>
<td>0.8 1.6</td>
<td>0.7 0.7</td>
<td>.77 .68</td>
<td></td>
</tr>
<tr>
<td>Does not feel as healthy as others</td>
<td>9.2 11.1</td>
<td>21.8 21.8</td>
<td>.002 .02</td>
<td></td>
</tr>
<tr>
<td>Health predicted to worsen</td>
<td>19.4 21.8</td>
<td>21.8 21.8</td>
<td>.69 .60</td>
<td></td>
</tr>
<tr>
<td>Impaired general vision</td>
<td>0.4 0.0</td>
<td>5.5 5.5</td>
<td>.01 .35</td>
<td></td>
</tr>
<tr>
<td>Impaired night driving</td>
<td>23.7 31.9</td>
<td>39.4 39.4</td>
<td>.90 .80</td>
<td></td>
</tr>
<tr>
<td>Impaired reading newsprint</td>
<td>11.4 15.0</td>
<td>21.5 21.5</td>
<td>.21 .96</td>
<td></td>
</tr>
<tr>
<td>Impaired reading road signs</td>
<td>8.1 14.2</td>
<td>17.6 17.6</td>
<td>.06 .59</td>
<td></td>
</tr>
<tr>
<td>Impaired recognizing people across the street</td>
<td>12.4 16.5</td>
<td>27.8 27.8</td>
<td>.07 .67</td>
<td></td>
</tr>
<tr>
<td>Impaired reading small print</td>
<td>26.0 31.5</td>
<td>35.7 35.7</td>
<td>.41 .99</td>
<td></td>
</tr>
</tbody>
</table>

*Numbers vary by up to 18 persons because of missing information.
†Outcomes were dichotomized and analyzed with logistic regression (see the “Methods” section for details).
‡Adjusted for age, sex, number of comorbid conditions, and current visual acuity (number of letters).
our results when we further adjusted the multivariate models for contrast sensitivity (results not shown).

Persons with ARM generally had decreased SF-36 scores and were more likely impaired in ADL, IADL, and visual function. Not all relationships were explained by vision. Differences in several of the mental scores from the SF-36 remained at least marginally significant after adjustment for current visual acuity and comorbidities. This may be explained by ARM’s association with high rates of depression. This was in contrast with findings of Mangione et al., who did not find ARM severity to correlate with any of the SF-36 scales. That study had a smaller sample and used different definitions, so their results cannot be directly compared with ours. Measuring quality of life with other instruments (eg, quality of well-being index, National Eye Institute Visual Function Questionnaire, activities of daily vision scale), other researchers have shown declines in quality of life for persons with ARM. Consistent measures of depression and visual function might permit a better understanding of the relationship of ARM to self-perceived quality of life.

The relationships we found with cataract were not significant after adjustment for current visual acuity and other comorbidities. This may suggest that the only negative effect of cataract on quality of life is visual impairment. This is consistent with findings from the Proyecto VER study that found an association of cataract with quality of life as measured by the National Eye Institute Visual Function Questionnaire, which was no longer significant after multivariate adjustment. Without adjustment for vision, the Age-Related Eye Disease Study found lower National Eye Institute Visual Function Questionnaire scores in persons with nuclear but not cortical cataract. They did not present results adjusting for vision.

Persons who have undergone cataract surgery were not included in the cataract analysis. Many recent studies have shown improvements in quality-of-life and functional measures after cataract surgery. Because we did not evaluate any of the quality-of-life outcomes before surgery, we cannot properly address associations with cataract surgery. In our study, persons who have undergone cataract surgery were older, had more comorbidities, and had poorer SF-36 scores than persons who had cataract or no known eye diseases (data not shown).

Other eye symptoms such as itching or dryness were not assessed in this analysis. Symptoms of dry eye and age-related eye disease were not related in Beaver Dam (M.D.K., unpublished data, 2004). Even though these symptoms have been shown to be associated with a decrease in quality of life, they have no impact on the results of our study. This study provided a unique opportunity to evaluate ocular conditions in a large population not selected for eye disease. Because of detailed grading procedures, comparisons can easily be made between diseased and nondiseased individuals. This study, however, has limitations. The data are cross-sectional, so we cannot evaluate changes in quality of life after an eye disease develops. Further, decreased quality-of-life measures may be attributable to other facets of the visual system not available to us (eg, itching). Also, many comparisons were evaluated in this study with no adjustment for multiple comparisons. While results should be interpreted with caution, they probably suggest the relative importance of age-related ocular disorders on quality of life and functional activities.

In summary, there is little evidence that having an age-related eye disease without visual impairment has a measurable impact on quality of life. It may actually have an effect at diagnosis (which we cannot measure), but humans are resilient, and if the eye disease does not affect function, they cope. Our data are compatible with the notion that decreased visual function, irrespective of the pathologic reason for the decrease, is associated with diminished quality of life and functional activities of living.

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REFERENCES


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