The Impact of Visual Impairment and Eye Disease on Vision-Related Quality of Life in a Mexican-American Population: Proyecto VER

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PURPOSE. To describe the relationship of visual acuity impairment and eye disease on vision-related quality of life, as measured by the 25-item National Eye Institute Visual Function Questionnaire (NEI-VFQ-25), in a cross-sectional, population-based study of older Hispanic persons living in Arizona.

METHODS. A random sample of block groups with Hispanic residents in Nogales and Tucson, Arizona, were selected for study. Participants were interviewed at home with a questionnaire that included the NEI-VFQ-25, an instrument measuring vision-related quality of life. Acuity was obtained with Early Treatment Diabetic Retinopathy Study (ETDRS) charts and standard protocol. Cataract was determined by clinical examination, diabetic retinopathy was diagnosed on stereo fundus photographs, and glaucoma was diagnosed on the basis of clinical examination and visual field results. Analyses were done to determine the degree of association between subscale scores and acuity in the better-seeing eye, monocular visual impairment, and specific eye diseases, with adjustment for acuity.

RESULTS. Of the 4774 participants in the study, 99.7% had completed questionnaires that were not completed by proxy. Participants with visual impairment had associated decrements in scores on all subscales, with a decrease in presenting acuity associated with a worse score (P < 0.05), after adjustment for demographic variables. Monocular impairment was also associated with lower scores in several subscales. In those with cataract, low acuity explained most of the low scores, but those with glaucoma or diabetic retinopathy had low scores independent of acuity.

CONCLUSIONS. In this study of Mexican-American persons aged 40 or more, monocular impairment and better-eye acuity was associated with a decrease in most domains representing quality of life. Subjects with uncorrected refractive error, cataract, diabetic retinopathy, and glaucoma had associated decrements in quality of life, many not explained by loss of acuity. Further work on the specific measures of vision associated with reported decreases in quality of life, such as visual field or contrast sensitivity, is warranted. (Invest Ophthalmol Vis Sci. 2002;43:3393–3398)

The Hispanic population is the fastest growing minority group in the United States, and there is considerable interest in the health status of this heterogeneous population.¹ In particular, the eye health of this population is of concern, because there is a relatively high rate of visual impairment² compared with that in non-Hispanic whites. In previous publications, we have reported high rates of diabetic retinopathy (DR) in a Mexican-American population, attributable to the high prevalence of diabetes in this group.³ Rates of glaucoma also appear to be higher than in the non-Hispanic white population.⁴ However, not much is known about the impact of visual impairment on the quality of life in this population. Impairment in acuity has been associated with self-reported difficulties in physical function,⁵–⁷ emotional distress,⁸ and low socialization⁹—all domains that are considered part of quality of life. As part of the validation of the National Eye Institute Visual Function Questionnaire (NEI-VFQ), decreases in scores associated with vision loss due to glaucoma, DR, and cataract have been reported.¹⁰–¹² However, the independent contributions of disease beyond acuity impairment have not been well characterized.

In a previous report, we described the psychometric properties of the short version, the NEI-VFQ-25, in this Mexican-American population, showing the association of visual acuity impairment and demographic variables with scores in quality-of-life domains.¹³ In that report, we demonstrated the validity of the NEI-VFQ-25 in this population by observing the association of decrements in quality of life with levels of visual impairment.

The purpose of this study was to determine the association of acuity using habitual distance correction (hereafter referred to as presenting acuity) and monocular impairment with quality-of-life domains and to determine the individual contribution of uncorrected refractive error, cataract, DR, and glaucoma to decrements in quality of life in a Mexican-American group.

METHODS

Population

Proyecto VER (Vision and Eye Research Project) is a population-based survey of visual impairment and blindness among noninstitutionalized Hispanics, aged 40 years or more living in Nogales or Tucson, Arizona. Sampling methods have been described elsewhere.³ In summary, a stratified random sample of block groups were selected based on census data of the Hispanic population in 1990. Every other household in Nogales block groups and two of every three households in Tucson block groups were chosen for determination of eligibility. All members of selected households who were self-described Hispanics aged 40 or more years were eligible to participate.
Table 1. 1996 NEI-VFQ-25

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Health</td>
<td>Five-level health rating</td>
</tr>
<tr>
<td>General Vision</td>
<td>Six-level vision rating</td>
</tr>
<tr>
<td>Near Vision</td>
<td>Reading ordinary print in newspapers</td>
</tr>
<tr>
<td></td>
<td>Work or hobbies that require you to see well up close</td>
</tr>
<tr>
<td></td>
<td>Finding something on a crowded shelf</td>
</tr>
<tr>
<td>Distance Vision</td>
<td>Reading street or shop signs</td>
</tr>
<tr>
<td></td>
<td>Going down stairs in dim light</td>
</tr>
<tr>
<td>Driving</td>
<td>Going out to see movies, plays, sports events</td>
</tr>
<tr>
<td></td>
<td>Driving during the day</td>
</tr>
<tr>
<td>Ocular Pain</td>
<td>Eye pain keeps you from activities</td>
</tr>
<tr>
<td></td>
<td>Amplitude of eye pain</td>
</tr>
<tr>
<td>Role Difficulties</td>
<td>Accomplish less because of vision</td>
</tr>
<tr>
<td></td>
<td>Limited in length of activities because of vision</td>
</tr>
<tr>
<td>Dependency</td>
<td>Stay home because of eyesight</td>
</tr>
<tr>
<td></td>
<td>Rely on others because of eyesight</td>
</tr>
<tr>
<td>Social Function</td>
<td>Need help from others because of eyesight</td>
</tr>
<tr>
<td>Mental Health</td>
<td>Seeing how people react to things you say</td>
</tr>
<tr>
<td></td>
<td>Visiting with people</td>
</tr>
<tr>
<td>Color Vision</td>
<td>Worry about eyesight</td>
</tr>
<tr>
<td></td>
<td>Worry about embarrassing myself because of eyesight</td>
</tr>
<tr>
<td>Peripheral Vision</td>
<td>Feel frustrated because of eyesight</td>
</tr>
<tr>
<td></td>
<td>Have less control of what I do because of eyesight</td>
</tr>
<tr>
<td></td>
<td>Picking out and matching your clothes</td>
</tr>
<tr>
<td></td>
<td>Noticing objects off to the side</td>
</tr>
</tbody>
</table>

After obtaining informed consent for participation, the participant was interviewed at home by trained personnel. The interview was followed by a complete ophthalmic examination at a central clinic site. A total of 4774 subjects participated in the interview and examination, for a response rate of 70.1%. All study procedures were approved by the Johns Hopkins University Joint Committee on Clinical Investigations and the University of Arizona Institutional Review Board and complied with the tenets of the Declaration of Helsinki.

Home Interview

The questionnaire was administered by trained personnel and offered in English and Spanish. The majority of home interviews (80%) were conducted in Spanish. The questionnaire contained specific questions on education, socioeconomic and health status, history of vision problems, visit to an eye care professional, and Native-American ancestry. Also included was the NEI-VFQ-25, and a series of questions on health care utilization, access, and insurance from the Hispanic Health and Nutrition Examination Survey (HHANES). An acculturation index was created by summarizing specific questions from HHANES regarding preferred language, country of birth, and other questions relating to adapting to U.S. culture. The acculturation score ranges from 1 to 5, where 1 is low acculturation, and 5 is high acculturation.

The NEI-VFQ-25 is a subset of the original 51-item NEI-VFQ. Subscales and items for the 1996 version used in this study are shown in Table 1. Items were answered in the following manner: “amount of difficulty,” “amount of time,” “amount true,” and amplitude. Item responses were adjusted for directionality (high scores reflect participants with good vision/health), and were rated on a scale of 0 to 100. Subscale scores were created by averaging their adjusted item responses. Participants’ responses were excluded from specific items if they had stopped the activity for reasons other than poor eyesight or if someone other than the participant had answered the questionnaire.

Clinical Measures

Presenting and best-corrected distance acuity were measured at the clinic. Acuity was measured in each eye with the participant using habitual distance correction. The following methods were used for assessing visual acuity in each eye: an autorefractor (Humphrey Instruments, San Leandro, CA) was used as a starting point for full subjective refraction. Distance acuity was tested with the Early Treatment diabetic retinopathy study (ETDRS) chart at 3 m, illuminated at 130 cd/m². Participants who failed to read the largest letters at 3 m were retested at 1.5 m and then at 1 m. Visual acuity was scored as the total number of letters read correctly, transformed to log of the minimum angle of resolution (logMAR) units. Failure to read any letters was assigned an acuity of 1.7 logMAR units, which is equivalent to an acuity of 20/1000. An E chart was used for participants who were illiterate. A person was considered to have uncorrected refractive error if the difference between best-corrected and presenting acuity was more than 2 lines.

After dilation, stereo fundus photographs of fields 1, 2, and 4 were taken and graded for presence and severity of DR, according to the modified Arlie House definition. For this analysis, a person with diabetes was considered to have DR if the grade exceeded 31 (moderate to proliferative retinopathy) in at least one eye.

An ophthalmologist examined lenses at the slit lamp. The Wilmer grading scheme was used to grade the severity and the type of lens opacity. For the purpose of this analysis, individuals were considered to have cataract if they had a nuclear grade of 4 (the highest grade), a cortical grade higher than 0.5, or posterior subcapsular cataract (PSC) in at least one eye. The narrowness of the anterior chamber was also examined at the slit lamp.

To identify glaucoma (open-angle and angle-closure), a glaucoma specialist (HAQ) reviewed charts of persons with the following characteristics: history of glaucoma, glaucoma thought to be present by the examining ophthalmologist, IOP of 22 mm Hg or more in either eye, shallow anterior chamber, visual field defect, or cup-to-disc ratio of 0.7 or greater. Visual field testing was performed in each eye that had 20/200 or better visual acuity with a threshold-testing program (Swedish interactive test algorithm [SITA] Fast, 24-2 protocol of the Zeiss-Humphrey Humphrey Field Analyzer [HFA II] instrument, Zeiss-Humphrey Systems, Dublin, CA). Applanation tonometry was performed in each person. Methods for diagnosing open-angle glaucoma and angle-closure glaucoma are described elsewhere.

Blood pressure was measured three times, according to a standardized protocol. The average of the final two readings was used to characterize blood pressure. Hypertension was defined as a positive answer to the question of whether the person has hypertension and is currently under treatment with antihypertensive medication or has systolic pressure of 160 mm Hg or higher or diastolic blood pressure of 90 mm Hg or higher.

Statistical Analysis

In previous work, we showed that the NEI-VFQ-25 was not only influenced by visual function, but by other demographic factors as well: age, gender, level of acculturation, income level, education level, location (Nogales or Tucson), and self-report of having medical insurance. These confounders were chosen because of their demonstrated effects on self-reported quality of life in this population and their association with eye disease. We adjusted for all these variables in the ensuing multivariate regression models to obtain more precise estimates of the relationship of vision with quality-of-life domains. Although diabetes was an important comorbid condition in this population, the models do not include diabetes as a covariate, because of its high association with DR; however, we adjusted for the presence of hypertension as a representative of comorbid conditions. All covariates, except age, were modeled as categorical variables.

We used presenting acuity in the better-seeing eye to characterize vision used on a daily basis. This approach was reasonable, because acuity in the better eye has been shown to be as good a predictor of self-reported functional status as other approaches of summarizing better- and worse-eye acuity. We modeled presenting acuity as a continuous variable (logMAR units) and analyzed the strength of the association between vision loss and subscale scores.
We also explored whether monocular impairment (presenting acuity in the worse eye worse than 20/40 and acuity in the fellow eye of 20/40 or better) influenced quality-of-life domains. Participants with presenting acuity in the better eye of 20/40 or better were used in the analysis, and comparisons were made between those with no impairment (both eyes had 20/40 or better acuity) and those who had monocular impairment (one eye had worse than 20/40 acuity). In addition, we adjusted for acuity in the better eye, because those with monocular impairment were more likely to have lower presenting acuity in the better eye than those without impairment.

Also assessed were the individual contributions of glaucoma, DR, cataract, and refractive error on quality-of-life domains. In a first model, we assessed these additive contributions without accounting for acuity impairment, to determine the contribution a particular disease has on quality of life. Those with any of these eye diseases or refractive error were compared with those with no evidence of eye disease nor refractive error. However, eye disease per se would not be expected to impact on quality of life unless there were an associated impact on some aspect of vision. In a second model, we tested this hypothesis by evaluating the additive contributions of eye disease (glaucoma, DR, and/or cataract) on quality of life, with adjustment for presenting acuity. In a third analysis, we added to the model second-order interaction terms between eye disease variables, to observe whether decrements in quality of life due to eye disease acted additively, or whether extra decrements occurred when two diseases were present. Participants with vision loss not due to glaucoma, DR, or cataract (e.g., macular degeneration, amblyopia, trauma) were excluded from these analyses because there were small numbers of people in these categories.

Because the data are from a cross-sectional sample, all inferences regarding the relationship of acuity and quality-of-life scores refer to the comparison of quality-of-life measures between individuals with different levels of acuity. Use of the words “decrease,” “decline,” or “loss” are meant only to describe the relationship between the measures of interest, rather than to imply a longitudinal shift in quality of life with a change in vision (or other measure).

Preliminary analysis showed that some NEI-VFQ-25 subscales had a potentially nonlinear relationship with presenting acuity: Distance Vision, Driving, and Mental Health. For these subscales, we allowed the slope of presenting acuity to change for acuity worse than 20/40 (spline regression).

Subscale score distributions were skewed toward the higher scores (e.g., ratings of excellent or no difficulty), resulting in linear model residuals that were independent but non-normally distributed. Confidence intervals will suggest false significance, because the standard error calculation from such models is based on residuals that are normally distributed. To better characterize the variation of the parameter estimates, we performed a nonparametric bootstrap on all models. A participant’s information was drawn at random, with replacement, from the observed values. Estimates from the linear models were calculated (a bootstrap estimate), and this process was repeated to create 1000 bootstrap estimates. A 95% bias-corrected confidence interval, was calculated, using the 2.5th and 97.5th percentiles of the bootstrap distributions.

**RESULTS**

Of the 4774 participants in the study, 13 (0.3%) had questionnaires completed by proxy and 7 participants refused to undergo measurement of refraction. Of the remainder, 175 participants did not receive a complete eye disease assessment, and 29 were diagnosed with eye disease other than glaucoma, DR, or cataract. These latter two groups totaling 204 were excluded from the analyses of eye disease and quality of life.

The average age for our sample was 56.9 years (range, 40–96; Table 2). Approximately two thirds of this sample had a yearly income below $20,000 and had less than a high school education. The participants had low acculturation scores, with a mean of 1.99 ± 0.95 (SD). Almost 80% chose to take the questionnaire in Spanish.

Table 3 describes the average decrement in score for each 2 lines of presenting acuity lost for each subscale of the NEI-VFQ-25. In all domains, scores showed significant decline as the logMAR increased, after adjustment for demographic variables. The slope change was the steepest in the domains of Role Difficulties (−6.23 change in score per 2 lines lost), Dependency (−5.27 change in score per 2 lines lost), and Near Vision (−5.26 change in score per 2 lines lost). For subscales with nonlinear associations with acuity, there were significantly steeper declines for those with vision worse than 20/40, especially in the Driving subscale, which showed a decline of −11.6 for every 2 lines lost.

Of the 4368 participants with presenting acuity in the better eye of 20/40 or better, 663 (15.2%) had acuity worse than 20/40 in the other eye (monocular impairment). Those with monocular impairment had average presenting acuity in the better eye of 0.12 ± 0.13 (SE) logMAR. In those with no impairment, average presenting acuity in the better eye was −0.04 ± 0.11 logMAR. Monocular impairment was associated with a modest decrease in quality of life, in all domains except General Health, Near Vision, Color Vision, and Ocular Pain (Table 4). The greatest decrements in scores of those with monocular impairment occurred in the visual tasks of Driving (−5.68) and General Vision (−3.44), as well as in Role Function (−4.45).

Subjects with cataract had mean better-eye acuity comparable to the acuity of those with glaucoma and DR (Table 5). Most persons with cataract had PSC only (149/374; 39.8%) or...
mixed cataract (86/374; 23.0%), with the greatest acuity impairment in those with nuclear cataract (average, 0.29 logMAR) and mixed cataract (86/374; 23.0%), with the greatest acuity impairment in those with nuclear cataract (average, 0.29 logMAR). As expected, there was a significant decrease in the Driving score (9.00 to 3.18) for those with glaucoma and cataract, but still the overall decrement in scale scores with DR was large, after adjustment for acuity. None of the scale scores was significantly different between those with cataract and those with no eye disease, except in Driving, after adjustment for acuity. This suggests that the effect of cataract on quality of life in this population was due to the effect on decreasing acuity. The models that included interactions between glaucoma, cataract, and DR, suggested that multiple eye disease was associated with additional decrements in quality of life, beyond the additive decrements associated with each disease separately. Table 8 shows the proportion of our participants with different combinations of eye disease. After adjustment for demographic variables, there was a significant additional decrement in score (range, −20.2 to −8.5, P < 0.05) in the scales of Near and Distance Vision, Driving, Ocular Pain, Role Function, Dependency, Mental Health, and Color Vision for those with both glaucoma and cataract. There was a significant decrease in Driving, Role Function, and Dependency (range, −17.8 to −14.5, P < 0.05) for those with glaucoma and DR, and there was also a significant decrease in the Driving score (−8.7, P = 0.04) for those with DR and cataract. However, the number of persons with combinations of eye disease was small and did not permit more detailed analyses.

### DISCUSSION

Visual acuity impairment was significantly associated with a decrement in all measured domains of self-reported, vision-related quality of life in this sample of Mexican-Americans.

### TABLE 4. Degree of Decrement in Subscale Scores of Those with Monocular Presenting Acuity Impairment, Compared with Those with 20/40 or Better Acuity in Both Eyes

<table>
<thead>
<tr>
<th>NEI-VFQ Subscale</th>
<th>Est.</th>
<th>Bootstrap 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>General health</td>
<td>−0.42</td>
<td>(−2.97 to 1.74)</td>
</tr>
<tr>
<td>General vision</td>
<td>−3.44</td>
<td>(−5.03 to −1.94)</td>
</tr>
<tr>
<td>Near vision</td>
<td>−1.39</td>
<td>(−3.18 to 0.54)</td>
</tr>
<tr>
<td>Distance vision</td>
<td>−2.45</td>
<td>(−4.07 to −0.85)</td>
</tr>
<tr>
<td>Driving</td>
<td>−5.68</td>
<td>(−8.24 to −3.19)</td>
</tr>
<tr>
<td>Peripheral vision</td>
<td>−3.02</td>
<td>(−4.92 to −1.25)</td>
</tr>
<tr>
<td>Color vision</td>
<td>−0.55</td>
<td>(−1.67 to 0.45)</td>
</tr>
<tr>
<td>Ocular pain</td>
<td>−0.76</td>
<td>(−2.62 to 1.22)</td>
</tr>
<tr>
<td>Role difficulties</td>
<td>−4.43</td>
<td>(−6.64 to −2.28)</td>
</tr>
<tr>
<td>Dependency</td>
<td>−2.34</td>
<td>(−3.99 to −0.76)</td>
</tr>
<tr>
<td>Social functioning</td>
<td>−2.08</td>
<td>(−3.21 to −1.03)</td>
</tr>
<tr>
<td>Mental health†</td>
<td>−3.66</td>
<td>(−4.75 to −2.59)</td>
</tr>
</tbody>
</table>

All models are adjusted for age, gender, acculturation, income, education level, location, and medical insurance. Est., estimate.

† Indicates a significant estimate.

### TABLE 5. Comparison of Mean LogMAR Acuity in the Better Eye of Participants with Cataract, Glaucoma, or DR

<table>
<thead>
<tr>
<th>Disease</th>
<th>n</th>
<th>Mean Acuity</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td>374</td>
<td>0.21</td>
<td>−0.26–1.7</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>100</td>
<td>0.22</td>
<td>−0.18–1.7</td>
</tr>
<tr>
<td>DR</td>
<td>290</td>
<td>0.12</td>
<td>−0.3–1.5</td>
</tr>
</tbody>
</table>
some physical tasks, related to driving and distance vision, steeper decreases in scores were observed once presenting acuity was worse than 20/40. Steeper declines in the mental health scale were also observed. These data suggest that self-reported decrement in quality of life was present even with modest visual loss, and that there was no threshold effect. The finding of a modest decrement in scores among those with monocular impairment with better-eye presenting acuity of 20/40 or better, further supports this statement.

Participants with glaucoma reported difficulties with driving and tasks of peripheral vision and feelings of dependency. The restrictions on independent functioning imposed by driving difficulties may have contributed to reports of low scores in dependency. The scores changed only slightly after adjustment for acuity, which was expected because glaucoma affects peripheral field before central field. Most persons with glaucoma do not lose central acuity until late in the course of disease (although, in this population, glaucoma was the leading cause of blindness21).

Participants with DR reported low scores in all domains, especially in general health. These participants, by definition, all had diabetes, and therefore low scores in health were expected. It is interesting that those with DR also reported low scores in near and distance tasks and that most of these difficulties were not explained by decreased acuity. A further analysis of the impact of DR on other measures of vision is warranted, because decrement in ability to perform these functions may explain decrements in quality of life better than impairment of acuity.

We have shown in previous work that the impact on self-reported physical function with loss in multiple measures of visual function is additive.22 For example, decreases in acuity and loss of visual fields produced additive effects on difficulties with physical function. In this study, we observed that the impact of cataract on quality of life was largely mediated through its effect on acuity alone. However, glaucoma and DR probably have other effects, apart from acuity, that have an impact on quality of life. Our findings are consistent with our previous work, in that those with glaucoma and DR were associated with larger decrements in scale scores than those with cataract.

Mangione et al.12 found similar results, in that patients with glaucoma, DR, and cataract had lower scores in all domains than did those with no evidence of eye disease. It is interesting that those with uncorrected refractive error reported decrements in quality of life that were comparable to decrements reported by participants with cataract. A prospective study would determine whether provision of adequate correction would result in improvement in function in all these domains.

### Table 6. Effect of Eye Disease on NEI-VFQ-25 Scale Scores, Compared with Those with No Eye Disease, and Adjusting for Demographic Variables

<table>
<thead>
<tr>
<th>NEI-VFQ Scale</th>
<th>Glaucoma</th>
<th>Diabetic Retinopathy</th>
<th>Cataract</th>
<th>Uncorrected Refractive Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bootstrap</td>
<td>95% CI</td>
<td>Bootstrap</td>
<td>95% CI</td>
</tr>
<tr>
<td>General health</td>
<td>-1.81</td>
<td>(-7.0 to 3.4)</td>
<td>-16.0*</td>
<td>(-18.8 to -13.5)</td>
</tr>
<tr>
<td>General vision</td>
<td>-6.50*</td>
<td>(-10.6 to -1.89)</td>
<td>-4.74*</td>
<td>(-6.76 to -2.74)</td>
</tr>
<tr>
<td>Near vision</td>
<td>-9.01*</td>
<td>(-14.5 to -2.87)</td>
<td>-8.44*</td>
<td>(-11.4 to -5.58)</td>
</tr>
<tr>
<td>Distance vision</td>
<td>-9.60*</td>
<td>(-15.3 to -3.62)</td>
<td>-8.64*</td>
<td>(-11.4 to -5.90)</td>
</tr>
<tr>
<td>Driving</td>
<td>-17.0*</td>
<td>(-28.2 to -6.04)</td>
<td>-11.7*</td>
<td>(-15.9 to -7.60)</td>
</tr>
<tr>
<td>Peripheral vision</td>
<td>-9.46*</td>
<td>(-15.2 to -3.99)</td>
<td>-6.22*</td>
<td>(-9.02 to -3.55)</td>
</tr>
<tr>
<td>Color vision</td>
<td>-5.78*</td>
<td>(-11.1 to -1.14)</td>
<td>-2.54*</td>
<td>(-4.77 to -0.93)</td>
</tr>
<tr>
<td>Ocular pain</td>
<td>-4.05</td>
<td>(-9.48 to 0.49)</td>
<td>-2.92*</td>
<td>(-5.53 to -0.23)</td>
</tr>
<tr>
<td>Role difficulties</td>
<td>-10.2*</td>
<td>(-13.8 to -6.87)</td>
<td>-10.2*</td>
<td>(-13.8 to -6.87)</td>
</tr>
<tr>
<td>Dependency</td>
<td>-14.6*</td>
<td>(-22.1 to -7.97)</td>
<td>-8.70*</td>
<td>(-12.1 to -5.87)</td>
</tr>
<tr>
<td>Social functioning</td>
<td>-8.04*</td>
<td>(-13.1 to -3.39)</td>
<td>-4.92*</td>
<td>(-7.14 to -2.64)</td>
</tr>
<tr>
<td>Mental health</td>
<td>-12.7*</td>
<td>(-19.3 to -6.95)</td>
<td>-9.73*</td>
<td>(-13.0 to -6.46)</td>
</tr>
</tbody>
</table>

* Indicates significant estimate (Est.).

### Table 7. Effect of Eye Disease on NEI-VFQ-25 Scale Scores, Adjusted for Presenting Acuity and Other Demographic Variables

<table>
<thead>
<tr>
<th>NEI-VFQ Subscale</th>
<th>Glaucoma</th>
<th>Diabetic Retinopathy</th>
<th>Cataract</th>
<th>Bootstrap</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bootstrap</td>
<td>95% CI</td>
<td></td>
<td>Bootstrap</td>
<td>95% CI</td>
</tr>
<tr>
<td>General health</td>
<td>-1.39</td>
<td>(-6.49 to 3.87)</td>
<td>-15.6*</td>
<td>(-18.5 to -13.2)</td>
<td>0.53</td>
</tr>
<tr>
<td>General vision</td>
<td>-5.14*</td>
<td>(-9.51 to -1.21)</td>
<td>-3.75*</td>
<td>(-5.68 to -1.68)</td>
<td>-1.23</td>
</tr>
<tr>
<td>Near vision</td>
<td>-7.69*</td>
<td>(-12.6 to -2.10)</td>
<td>-6.96*</td>
<td>(-9.88 to -4.24)</td>
<td>-0.89</td>
</tr>
<tr>
<td>Distance vision</td>
<td>-7.08*</td>
<td>(-13.4 to -2.68)</td>
<td>-6.99*</td>
<td>(-9.62 to -4.38)</td>
<td>1.41</td>
</tr>
<tr>
<td>Driving</td>
<td>-14.8*</td>
<td>(-25.4 to -4.32)</td>
<td>-10.1*</td>
<td>(-14.1 to -6.32)</td>
<td>-3.65*</td>
</tr>
<tr>
<td>Peripheral vision</td>
<td>-8.47*</td>
<td>(-14.0 to -3.25)</td>
<td>-5.14*</td>
<td>(-7.92 to -2.65)</td>
<td>0.17</td>
</tr>
<tr>
<td>Color vision</td>
<td>-5.19*</td>
<td>(-10.4 to -0.94)</td>
<td>-1.87*</td>
<td>(-4.04 to -0.26)</td>
<td>0.09</td>
</tr>
<tr>
<td>Ocular pain</td>
<td>-3.18</td>
<td>(-8.57 to 1.19)</td>
<td>-2.16</td>
<td>(-4.70 to 0.49)</td>
<td>2.35</td>
</tr>
<tr>
<td>Role difficulties</td>
<td>-9.58*</td>
<td>(-15.4 to -3.65)</td>
<td>-8.55*</td>
<td>(-11.7 to -5.38)</td>
<td>-2.03</td>
</tr>
<tr>
<td>Dependency</td>
<td>-13.0*</td>
<td>(-20.3 to -6.94)</td>
<td>-7.29*</td>
<td>(-10.4 to -4.58)</td>
<td>-0.84</td>
</tr>
<tr>
<td>Social functioning</td>
<td>-7.28*</td>
<td>(-12.0 to -2.97)</td>
<td>-4.07*</td>
<td>(-6.19 to -1.99)</td>
<td>-0.45</td>
</tr>
<tr>
<td>Mental health</td>
<td>-10.5*</td>
<td>(-16.4 to -4.97)</td>
<td>-8.15*</td>
<td>(-11.3 to -5.28)</td>
<td>-0.62</td>
</tr>
</tbody>
</table>

* Indicates significant estimate (Est.)
Although it is reasonable to suppose that difficulties in tasks embedded in the near distance and driving scales would be resolved with adequate correction, the impact on psychological and social function is not clear and deserves study.

Having more than one eye disease appeared to have a multiplicative effect in most domains, especially in participants with glaucoma and cataract. This finding suggests that removing cataract in the presence of other eye disease may significantly improve quality of life in these subjects.

A main limitation in our analysis of visual impairment and vision-related quality of life was the availability of data only on central acuity impairment. Clearly, visual impairment may have multiple dimensions, such as loss of contrast sensitivity, peripheral field, stereo acuity, and other measures. We did not capture other aspects of visual impairment, except for visual fields, which were used in the diagnosis of glaucoma. Decrements in these other aspects of vision may correlate more closely with decrements in specific domains. Also, we did not collect detailed comorbidity information from participants. Information such as hearing loss, heart disease, arthritis, or stroke may have been useful in also predicting declines in domains such as Social Function and Dependency. Obviously, increasing severity of disease would have some impact on vision and thus an increasing impact on quality of life, but we did not make such an analysis. We also did not address disease-specific issues, such as the effect of visual field loss on quality of life in those with glaucoma.

In summary, our data suggest that visual acuity impairment, in both the better- and the worse-seeing eyes, was associated with a decrease in quality of life within the Mexican-American sample studied, and the steepness of that decrease was associated with level of visual impairment. Uncorrected refractive error, cataract, DR, and glaucoma all were associated with decrements in quality of life, many not explained by the impact of acuity. Further longitudinal studies on the impact of remediation of vision loss on quality of life in this population are warranted.

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References