Relationship between Vision Impairment and Eye Disease to Vision-Specific Quality of Life and Function in Rural India: The Aravind Comprehensive Eye Survey

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Purpose. To determine the impact of vision impairment and eye diseases on vision-specific quality of life and visual function in an older population of rural southern India.

Methods. Presenting and best-corrected visual acuity and burden of eye diseases were determined in a population aged 40 years and older, identified through a random cluster sampling strategy from 50 villages of rural south India. A questionnaire validated previously for use in this population was used to ascertain quality of life and visual function. Visual acuity measurements were obtained with illiterate E Early Treatment Diabetic Retinopathy Study (ETDRS) charts. Cataract was graded and defined based on the Lens Opacities Classification System (LOCS) III. Macular degeneration was defined based on the classification system proposed by the International ARM Epidemiologic Study Group. Glaucoma was defined based on results of clinical examinations including optic disc and visual fields. Analyses were performed to explore the relationship of overall and subscale quality-of-life and visual function scores with presenting acuity in the better-seeing eye, specific eye diseases, and demographic variables.

Results. Information on quality of life and visual function were available for 5119 (99.4%) of 5150 study subjects. The mean presenting visual acuity in the better eye was 0.76 ± 0.53 logMAR (logarithm of the minimum angle of resolution) units. Age, education, occupation, presenting acuity in the better eye, and presence of a cataract, glaucoma, or refractive error were independently associated with overall quality-of-life and vision function scores. After adjustment for demographic variables and ocular disease, persons with vision impairment or bilateral blindness based on presenting visual acuity had lower scores across all domains of quality of life and vision function. Scores for subscales of quality-of-life and vision function domains were significantly lower among those with age-related cataract and glaucoma compared with persons without those eye diseases.

Conclusions. Presenting vision in the better eye was associated with quality of life and vision function in this older population of rural south India. Subjects with glaucoma and age-related cataract had an associated decrease in quality of life and vision function, independent of presenting visual acuity in the better eye. (*Invest Ophthalmol Vis Sci.* 2005;46:2308–2312) DOI: 10.1167/iovs.04-0830

A significant proportion of the blind persons in the world reside in India, and a demographic transition toward aging with increasing life expectancy will add significantly to India's burden of blindness and vision impairment.[1,2] We have reported that persons between 40 and 90 years of age in rural south India are approximately twice as likely to be blind (defined as visual acuity worse than 20/200 in the better-seeing eye) compared with black persons elsewhere and are approximately three times as likely to be blind as are white persons.[2] The prevalence of blindness in rural south India in those between 55 and 90 years of age is approximately five times that reported in white populations elsewhere.[2] Information on the prevalence of cataract, age-related macular degeneration, diabetic retinopathy, glaucoma, and other eye diseases and the risk factors for these diseases have been reported in this rural south Indian population.[3–5]

Studies on utilization of eye care services in south India have consistently reported under-utilization of services and have attributed much of the reasons for under-utilization to the accessibility, availability, and affordability of services.[6,7] It is also possible that utilization of services in this population is related to functional needs. Studies performed in other populations have demonstrated the impact of vision impairment and eye diseases on visual function and quality of life.[8–10] Although a previously validated questionnaire to determine vision-specific quality of life of populations in south India is available, little information is available to relate the impact of vision impairment or eye diseases to vision-specific quality of life and function in this population.[11] Work on quality of life with respect to eye diseases in south India has, to date, consisted of comparisons of the impact of different cataract surgical procedures on vision-related function.[12,13] We examined associations of vision impairment and blindness with quality-of-life domains and vision-specific function and explored the impact of major eye diseases—age-related cataract, uncorrected refractive errors, glaucoma, and age-related macular degeneration—on vision-specific quality of life and function as part of a comprehensive eye survey among older adults in rural south India.

Methods

The Aravind Comprehensive Eye Survey (ACES) is a population-based survey of adults 40 years of age or older to assess the burden of ocular morbidity and vision impairment in rural south India. The study was

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approved and is annually reapproved by the Committee on Human Research at the Johns Hopkins Bloomberg School of Public Health and by the Ethical Review Committee of the Aravind Eye and Children's Hospitals and adhered to the tenets of the Declaration of Helsinki. The details of the methodology of the study and sample selection have been published.[2] To summarize, a two-stage, random cluster sampling technique was used to identify 50 study sectors from within 50 rural villages of three southern districts of the state of Tamil Nadu in south India. This sample can be considered to be representative of rural areas in southern India but not necessarily of urban areas in southern India or of rural or urban areas in other parts of India.

We measured presenting and best-corrected visual acuity using illiterate E ETDRS charts at 4-m distance. Participants failing to read the largest letters at 4 m were retested at 2- and 1-m distances. Participants were deemed to have sufficient visual acuity to read a particular line if a minimum of four of five letters in a line were identified correctly. Visual acuity was then transformed to log of minimum angle of resolution (logMAR) units. We assigned a visual acuity of 1.7 logMAR units for participants who were unable to read any of the letters, even at 1 m. We used presenting visual acuity for further analysis relating to this manuscript, as visual function in daily life is a function of presenting rather than best-corrected vision.

We considered a person to have uncorrected refractive error if the difference between presenting and best-corrected vision was more than 2 lines and optical correction was responsible for this difference. We used the Lens Opacities Classification System (LOCS) III to grade the lens at the slit lamp under standard testing conditions.[14] We determined individuals to have current, definite age-related cataract if they had LOCS III nuclear opalescence ≥3.0 and/or cortical cataract ≥3.0 and/or posterior subcapsular cataract (PSC) ≥2.0 in either eye.[4] We performed gonioscopy to examine the angles of the anterior chamber and classified the angle based on the system proposed by Shaffer.[15] We measured intraocular pressure with Goldmann applanation tonometry and performed a central 24-2 visual field examination by automated perimetry (Humphrey Visual Field Analyzer; Carl Zeiss Meditec, Dublin, CA) in all study participants. The presence of glaucoma was defined independent of intraocular pressure. The methods of diagnosing and classifying glaucoma have been published previously.[3] Posterior segment examinations were performed with indirect ophthalmoscopy and 78-D lens examinations at the slit lamp after the pupils were dilated. We classified age-related macular degeneration based on the classification system proposed by the International ARM Epidemiologic Study Group.[16]

We measured blood pressure in study participants by using standard procedures, and the median of three readings was used in the analysis. We defined systemic hypertension as measured systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg or current use of systemic antihypertensive medications.[17,18] We used a glucometer and strips to test for blood sugar levels. We obtained capillary blood for examination after a finger prick with a sterile lancet 2 hours after the subject had eaten breakfast. We defined diabetes as measured postprandial blood sugar of ≥180 mg/dL or current use of blood sugar–lowering medications. Facilities for glycosylated hemoglobin estimations were not available in the study districts during the period of study and hence were not performed.

We used an instrument previously validated for use in this population to determine the vision-specific quality-of-life and visual function scores.[11] This quality-of-life questionnaire included questions concerning the activities of daily living, mobility, social activities, and mental state. For each of these questions, if the subject responded that he or she had any difficulty with the activity, the subject was asked whether the difficulty was related to vision. The quality-of-life scores presented herein are those specific to difficulty with activities with which vision was associated. The visual function questionnaire included questions on general vision, visual perception, sensory adaptation, and depth perception. Social workers previously trained in the administration of these questionnaires conducted interviews at the hospital before visual acuity measurements and ocular examination. Each item in the questionnaire was answered with a four-point scale ranging from "not at all" to "a lot." We calculated a total score for each of the questions and subscales and expressed this score as a percentage of the total possible obtainable score ranging from 0 to 100, with higher scores indicating better results.

The purpose of these analyses was to examine the associations between quality-of-life scores and demographic, systemic, and ocular morbidity and vision-specific variables. Similarly, we assessed the association between these variables and visual function scores. Demographic variables included age (categorized by decade), sex, education (none, primary or middle, and secondary or higher), and occupation (none, farmer or laborer, professional/business, government). Morbidity included hypertension, diabetes, cataract, glaucoma, age-related macular degeneration, and refractive error. Presenting visual acuity in

TABLE 1. Characteristics of 5119 Subjects in Aravind Comprehensive Eye Survey

	n	QOL Score (SD)	VF Score (SD)
All subjects	5119	87.8 (21.4)	58.0 (15.3)
Age (y)			
40–49	2051	96.1 (11.2)	64.5 (10.4)
50–59	1457	89.5 (19.1)	58.4 (14.0)
60–69	1197	78.8 (25.0)	51.0 (16.4)
70+	414	66.8 (30.3)	44.0 (18.3)
Sex			
Males	2819	87.5 (21.5)	57.8 (15.1)
Females	2300	88.2 (21.2)	58.1 (15.4)
Occupation			
Farmer (land owner)	791	92.5 (15.8)	61.4 (12.3)
Farmer (laborer)	2108	89.5 (18.5)	57.4 (13.6)
Other laborer	599	92.0 (15.5)	61.7 (12.0)
Government worker	209	97.9 (6.2)	67.2 (8.2)
Office worker	43	97.5 (8.8)	66.0 (11.6)
Salesman	105	89.4 (20.9)	61.0 (14.5)
Businessman	82	94.9 (14.2)	63.1 (13.1)
Professional	14	91.8 (17.4)	62.8 (12.2)
None	1152	76.3 (29.2)	51.4 (19.3)
Other	3	88.9 (19.2)	62.5 (2.1)
Unknown	13	100 (0.0)	96.6 (12.1)
Education			
Illiterate	2014	82.1 (25.1)	53.7 (16.5)
Functional literate	505	90.2 (18.3)	56.9 (13.2)
Primary	1345	88.9 (20.4)	59.1 (14.8)
Middle	668	93.4 (14.8)	61.8 (12.2)
Secondary	424	96.5 (10.5)	65.6 (10.1)
Higher secondary	84	97.1 (5.3)	66.8 (7.4)
Graduate	35	99.7 (0.7)	70.8 (5.1)
Postgraduate	24	90.8 (18.9)	63.3 (13.6)
Professional	5	92.9 (5.0)	63.3 (11.8)
Diseases			
Hypertension	1056	86.1 (22.2)	56.2 (15.6)
Diabetes	227	84.9 (23.3)	56.2 (17.0)
Cataract	2234	80.2 (25.5)	51.6 (16.8)
Glaucoma	132	74.0 (28.8)	47.8 (18.3)
Macular degeneration	161	82.9 (23.4)	56.5 (15.7)
Refractive error	2989	55.7 (15.6)	85.1 (23.1)
Visual acuity in better eye			
≥20/60	2319	97.1 (7.7)	65.4 (8.9)
<20/60 to 20/200	1366	88.3 (18.1)	57.9 (13.1)
<20/200 to 20/400	723	79.8 (24.7)	50.1 (14.6)
<20/400	705	64.8 (31.3)	41.4 (18.8)
Mean presenting acuity			
In better eye			0.8 ± 0.5
With cataract			1.0 ± 0.5
With glaucoma			1.2 ± 0.7
With macular degeneration			1.0 ± 0.6
With refractive error			1.0 ± 0.5

QOL, quality of life; VF, visual function score.

Table 2. Differences in Quality-of-Life and Visual Function Scores by Demographic Characteristics, Morbidity and Visual Acuity

	Quality of Life		Visual Function	
	Without VA	With VA	Without VA	With VA
Age (y)				
40–49	92.2	89.8	61.1	59.3
50–59	−2.6 (−4.0, −1.2)	−0.8 (−2.1, 0.5)	−2.4 (−3.4, −1.4)	−0.8 (−1.7, 0.1)
60–69	−9.3 (−10.9, −7.7)	−4.5 (−6.1, −2.9)	−6.9 (−8.0, −5.8)	−2.9 (−4.0, −1.8)
70+	−18.7 (−20.9, −16.5)	−10.7 (−12.9, −8.5)	−12.9 (−14.4, −11.4)	−6.4 (−7.9, −4.9)
Education				
None	85.4	86.1	49.8	56.6
Primary/middle	4.3 (3.2, 5.4)	2.8 (1.8, 3.8)	3.5 (2.7, 4.3)	2.2 (1.5, 2.9)
Secondary+	6.7 (4.8, 8.6)	4.5 (2.7, 6.3)	6.0 (4.7, 7.3)	4.1 (2.9, 5.3)
Occupation				
None	80.7	82.3	48.6	56.0
Farmer/laborer	9.3 (8.0, 10.6)	7.0 (5.7, 8.3)	4.0 (3.1, 4.9)	2.3 (1.4, 3.2)
Office/other	8.2 (6.0, 10.4)	6.3 (4.3, 8.3)	4.9 (3.4, 6.4)	3.4 (2.0, 4.8)
Morbidity				
No cataract	89.4	89.6	54.9	59.7
Cataract	−6.7 (−8.0, −5.4)	−3.9 (−5.2, −2.6)	−6.4 (−7.3, −5.5)	−3.8 (−4.7, −2.9)
No glaucoma	88.0	87.9	51.9	58.0
Glaucoma	−6.2 (−9.5, −2.9)	−4.6 (−7.7, −2.9)	−4.8 (−7.1, −2.5)	−3.4 (−6.7, −0.1)
No refractive error	88.7	85.8	52.5	56.2
Refractive Error	−1.5 (−2.6, −0.4)	3.3 (2.1, 4.5)	−1.2 (−3.0, −0.4)	2.9 (2.1, 3.7)
Presenting visual acuity				
≥20/60		94.3		63.5
20/60 to 20/200		−5.9 (−7.4, −4.4)		−5.5 (−6.5, −4.5)
20/200 to 20/400		−11.2 (−13.1, −9.3)		−10.8 (−12.1, −9.5)
<20/400		−24.5 (−26.5, −22.5)		−18.2 (−20.5, −17.9)

Data were obtained in linear regression models. Adjusted mean scores are given for the reference categories. Data are expressed as the regression coefficients (95% CI). VA, visual acuity.

the better eye was categorized as 20/60 or better, <20/60 to 20/200, <20/200 to 20/400, or worse than 20/400. We also ran models using visual acuity as a continuous variable using the logMAR scale. Quality-of-life scores were skewed to higher values, but visual function scores were approximately normally distributed. However, because of the large sample size, we fit linear regression models for both outcomes and used *t*-based 95% confidence intervals for the regression coefficients. After selecting the demographic and morbidity covariates to be included in the models, we ran the models, with and without visual acuity. Both sets of models are presented to demonstrate the changes in coefficients associated with quality-of-life and visual function scores, with and without visual acuity as an explanatory variable. We also examined the subscales of quality of life and vision function scores, by using the same linear regression models for the overall scores.

Results

Eye examinations were performed in 5150 (96.5%) of 5337 enumerated persons. We completed quality-of-life and vision function questionnaires for 5119 (99. 4%) of 5150 participants who had ocular examinations. The mean age of participants in our study sample was 52.9 ± 10.1 years, and 2819 (55.1%) were men. Sixty percent (n = 3090) of the population had at least 1 year of formal education, and 3951 (77.4%) were engaged in occupations providing them with remuneration, primarily agricultural labor. Demographic details and details of ocular and systemic morbidity in this population are presented in Table 1.

The mean presenting visual acuity in the better eye was 0.8 ± 0.5 logMAR units. The mean quality-of-life and visual function scores were 87.8 ± 21.4 and 58.0 ± 15.3, respectively. Persons with glaucoma had the worst mean presenting acuity in the better eye (Table 1) compared with those with cataract, age-related macular degeneration, or uncorrected refractive errors.

Age, education, occupation, cataract, glaucoma, refractive error, and visual acuity were all associated with quality-of-life and visual function scores in multivariate regression models (Table 2). Sex, hypertension, diabetes, and age-related macular degeneration were not associated with quality-of-life and visual function scores in the multivariate models, with or without visual acuity. As expected, quality-of-life and visual function scores declined with age and were higher in those with education and occupations than in subjects without education and without occupations. Scores were lower in those with cataract, glaucoma, and refractive error in the models without visual acuity. When visual acuity was added to the models, there was an attenuation of the effect of the covariates on scores, although the associations continued to be in the same direction and statistically significant. The exception was refractive error: Those with refractive error had lower scores than those without refractive error in the models without visual acuity, but had higher scores when visual acuity was added to the models This increase in scores occurred because, among those without visual acuity loss, the scores were the same among those with and without refractive errors, but the scores declined more rapidly with declines in visual acuity among those without refractive error than among those with refractive error.

The subscales for quality of life and visual function were all significantly associated with visual acuity (Table 3) and with cataract and glaucoma, independent of visual acuity (Table 4). The worse the acuity, the greater the deficit in the subscales. Deficits in visual acuity affected depth perception less than the other subscales of visual function, and deficits in visual acuity affected quality-of-life and visual function subscales similarly.

TABLE 3. Difference in Subscale Scores between Those without Presenting Visual Impairment (≥20/60) and Those with Impairment and Blindness

Subscales	(<20/60 to 20/200)	(<20/200 to 20/400)	(<20/400)
Quality of life			
Activities of daily living	−2.5 (−4.8, −1.2)	−7.0 (−8.8, −5.2)	−19.4 (−21.2, −17.6)
Mobility	−5.1 (−6.7, −3.5)	−10.2 (−11.3, −8.1)	−23.4 (−25.6, −21.2)
Social	−3.2 (−4.2, −2.2)	−7.6 (−8.9, −6.3)	−17.2 (−18.6, −15.8)
Mental	−5.1 (−6.6, −3.6)	−10.6 (−12.6, −8.6)	−22.4 (−23.5, −20.3)
Visual function			
General vision	−6.2 (−7.4, −5.0)	−10.6 (−12.1, −9.1)	−14.6 (−16.1, −13.1)
Visual perception	−5.4 (−6.4, −4.4)	−11.4 (−12.4, −10.4)	−19.2 (−20.5, −17.9)
Peripheral vision	−4.3 (−5.5, −3.1)	−10.4 (−12.0, −8.8)	−21.1 (−22.7, −19.5)
Sensory adaptation	−3.2 (−4.2, −2.2)	−8.1 (−9.4, −6.8)	−15.7 (−18.0, −14.4)
Depth perception	−2.0 (−3.1, −0.9)	−6.3 (−7.8, −4.8)	−15.9 (−17.4, −14.4)

Data are the regression coefficients (95% CI). All models adjusted for age, education, occupation, and presence of cataract, glaucoma and refractive error.

DISCUSSION

The high response rates to ocular examinations and completion of questionnaires, the random selection of study subjects, and the population-based design are strengths of this study. Data from our investigation suggest that vision impairment is associated with a significant decrease across all domains of quality of life and visual function in an older population of rural south India. These findings are consistent with reports of populations elsewhere.[8–10]

Participants with age-related cataract reported difficulty across all domains of quality of life and visual function, suggesting that cataract extraction may improve quality of life and visual function in this population. An impact of cataract surgery on quality of life and visual function has been reported in this population.[12,13] Subjects with glaucoma reported a greater reduction in general vision than persons with age-related cataract. Some of this deficit in vision may be due to the poorer visual acuity in those with glaucoma than in those with cataract, but this difference persisted after adjustment for visual acuity. Some of the deficit may be due to the combination of peripheral and central vision loss, although the reduction in peripheral vision scores was similar for both the diseases. The presence of cataract and glaucoma in the same person had a multiplicative effect on all domains, suggesting that cataract extraction in persons with coexisting cataract and glaucoma may significantly improve quality of life and visual function, although not necessarily to a normal level.

Our data suggest that the effects on quality of life and visual function in this rural population are determined by the effects of decreased visual acuity, with some residual effect of ocular disease independent of visual acuity. We found a reduction in scores across domains for glaucoma to be similar to those for age-related cataract. The lack of association between age-related macular degeneration and quality of life or visual function may be explained by the fact that most of the cases of macular degeneration in this population were of the early type, although the mean presenting visual acuity in persons with macular degeneration was 0.97 ± 0.6 logMAR units, similar to that in those with cataract.[5]

TABLE 4. Difference in Subscale Scores between Those with and without Cataract or Glaucoma

Subscales	Cataract	Glaucoma
Quality of life		
Activities of daily living	−3.4 (−4.7, −2.1)	−2.0 (−5.1, 1.1)
Mobility	−5.4 (−6.1, −4.7)	−6.2 (−9.9, −2.5)
Social	−1.5 (−2.5, −0.5)	−4.0 (−6.3, −1.7)
Mental	−4.5 (−6.0, −3.0)	−5.6 (−9.2, −2.0)
Visual function		
General vision	−5.6 (−6.7, −4.5)	−6.2 (−8.9, −3.5)
Visual perception	−4.5 (−5.4, −3.6)	−2.4 (−4.6, −0.2)
Peripheral vision	−5.9 (−7.0, −4.8)	−7.5 (−10.2, −4.8)
Sensory adaptation	−3.0 (−3.9, −2.1)	−3.3 (−5.5, −1.1)
Depth perception	−4.6 (−5.7, −3.5)	−5.5 (−8.1, −2.9)

Data are adjusted for age, education, occupation, presenting visual acuity in the better eye, and presence of refractive error and are expressed as the regression coefficients (95% CI)

The association of psychosocial domains with glaucoma requires further study. We have reported that the majority of the subjects with glaucoma in this rural population had not had the disease diagnosed and were not in treatment for glaucoma before our survey.[19] It is unlikely that the reduction in scores in psychosocial domains is related to difficulties associated with prolonged medication, because most of the subjects were not taking medications. The lack of medication for glaucoma on a regular basis limits our ability to validate this assumption.

The cross-sectional design of our study has to be considered while interpreting the reduction in quality of life and visual function across domains. The reduced scores we report are based on comparisons between individuals and do not necessarily indicate a longitudinal shift in the quality of life or vision function with a change in vision or disease status. Several other limitations also should be considered while interpreting the data. Although we performed visual field examinations on all participants, these were primarily used for the diagnosis of glaucoma. We did not explore the potential effects of visual field loss on quality of life and its relationship with central vision loss. We also have not explored the effects of other measures of visual acuity, including stereovision and contrast sensitivity. It is possible that the reduction in scores across domains that occurred after adjustment for visual acuity is influenced by these measurements of visual function. We also did not have information on comorbidity other than systemic hypertension and diabetes.

Further longitudinal studies on the impact of therapy for uncorrected refractive errors and glaucoma on quality of life and visual function in this rural population are needed. Prior studies in this and other populations have shown significant improvement in quality of life and visual function after cataract surgery. Our results suggest that improvements may be obtained after correction of refractive errors and that this improvement is a function of visual acuity. The potential effects of other measures of vision, including stereopsis, contrast, and fields on visual function and quality of life also should be explored further.

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