Ophthalmic Epidemiology, 13:371–377, 2006

ISSN: 0928-6586
DOI: 10.1080/09286580600864794

informa
healthcare

ORIGINAL ARTICLE

Assessment of Vision-Related Quality of Life in an Older Population Subsample: The Blue Mountains Eye Study

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ABSTRACT *Purpose*: To assess visual functioning and vision-specific health-related quality of life (HRQOL) in an older, community-dwelling-based population subsample, using the 25-item National Eye Institute Visual Function Questionnaire (NEI-VFQ-25). *Methods*: Three-quarters (76%, n = 892) of Extension Blue Mountains Eye Study participants (aged ≥50 years, mean 60.8 years) completed the self-administered NEI-VFQ-25, an instrument consisting of 12 dimensions and one summary composite score, and comprehensive eye examinations, including monocular distance visual acuity. Visual impairment was defined as visual acuity <6/12. Unilateral and bilateral visual impairment was defined by the worse eye and better eye, respectively. Correctable visual impairment was defined as that which improved, and non-correctable visual impairment as that which persisted after subjective refraction. Mild visual impairment was defined as visual acuity <6/12 but ≥6/24, moderate as <6/24 but ≥6/60, and severe as <6/60. *Results*: There were no significant differences in age, sex, or vision status between NEI-VFQ-25 responders and non-responders. Men had significantly better scores in three subscales than women but there were no significant differences in their overall composite scores (men 88.5±0.5; women 88.1±0.4). Persons aged 60–69 years had the best NEI-VFQ-25 profiles (mean composite score ± standard error, 90.2 ± 0.5; 50–59 years, 88.5 ± 0.4; ≥70 years, 86.2 ± 0.8). Presenting bilateral visual impairment (77.1 ± 1.4) was associated with significantly poorer functioning than unilateral (87.5 ± 0.8) or no visual impairment (89.4 ± 0.3). Increasing levels of impairment were associated with poorer levels of visual functioning. The impact of impairment was principally from non-correctable (49.2 ± 2.6) rather than refractive impairments (85.3 ± 1.4), although the latter accounted for over three-quarters (77.5%) of presenting bilateral impairment. Non-correctable unilateral impairment (85.3 ± 1.1) was associated with poorer functioning than no impairment. *Conclusions*: The findings from this community-dwelling older population show that the NEI-VFQ-25 differentiates well between various levels of visual impairment with regard to the magnitude of their impact on vision-specific quality of life. Greater impacts

Accepted 13 June 2006

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were noted among persons with bilateral compared to unilateral impairment, with increasing impacts at greater severities of visual impairment. Visual impairment from refractive errors is more frequent than from underlying pathologic disorders, but the impact of correctable visual impairment was considerably milder than the impact of non-correctable visual impairment.

KEYWORDS Quality of life; elderly subjects; National Eye Institute Visual Function Questionnaire (NEI-VFQ-25); the Blue Mountains Eye Study; visual impairment; visual functioning

INTRODUCTION

The National Eye Institute Visual Function Questionnaire (NEI-VFQ) is a vision-specific health-related quality of life (HRQOL) instrument designed to measure vision-related functioning and well-being across multiple dimensions and ophthalmic conditions[1,2] and is increasingly important in ophthalmic research. This patient-based subjective instrument is increasingly important in supplementing both traditional objective clinical measures and generic HRQOL instruments due to its more comprehensive assessment of the impacts on elements of visual functioning.[3,4] This report supplements our recent reports of the impacts of visual impairment on general HRQOL.[5,6]

The increasing use of the NEI-VFQ over other similar questionnaire instruments has been due to its specific design for ophthalmic patients in general, rather than being specific for patients with cataracts.[7,8] It was also developed to assess areas of functioning and well-being identified as important by persons with eye disease.[1] The reliability and validity of the shorter 25-item version (NEI-VFQ-25) has been demonstrated to be comparable to the 51-item Field Test Version.[2,9]

The use of the NEI-VFQ-25 has been reported in a number of American population-based cohorts, including the Wisconsin Epidemiologic Study of Diabetic Retinopathy,[10] the Vision and Eye Research Project (Proyecto VER),[11,12] and the Los Angeles Latino Eye Study (LALES).[13,14] To date, however, its use has not been reported from any large Australian population-based sample. Hence, this report aims to assess vision-specific HRQOL and the impact of age-related visual impairment in a population-based sample of community-living older Australians using the self-administered NEI-VFQ-25.

METHODS

Study Population

The Blue Mountains Eye Study (BMES) is a population-based study of visual impairment and common eye diseases in an older community-living Australian population.[15] Study procedures were approved by the University of Sydney Human Research Ethics Committee and were in accordance with the tenets of the Declaration of Helsinki, and written informed consent was obtained from all participants.

The first BMES examined 3654 (82.4%) residents, aged ≥49 years, identified in a door-to-door census of two postcode areas (2780, 2782) west of Sydney during 1992–4.[15] The Extension BMES identified 1378 newly eligible residents in a similar way, of which 1174 (85.2%) participated during 1999–2001. This paper reports findings from the Extension population.

Instrument Used

The NEI-VFQ-25[9] contains 25 items measuring 12 subscales ('general health,' 'general vision,' 'ocular pain,' 'near vision', 'distance vision', 'social function', 'mental health', 'role difficulty', 'dependency', 'driving', 'colour vision', and 'peripheral vision') and summarised by the 'composite scale'. Each subscale is scored from 0 (worst rating) to 100 (best rating) by coding, summating, and transforming its relevant item scores as outlined by the National Eye Institute. The 'composite scale' is the average score of all vision-specific subscales. The NEI-VFQ-25 was chosen over the 39-item version because the shorter version minimises participant fatigue whilst having proven validity and reliability.[9]

Data Collection

Participants attended a comprehensive eye examination, including monocular distance LogMAR visual acuity according to the methods of the Early Treatment Diabetic Retinopathy Study (ETDRS), both with habitual correction (presenting visual acuity) and after subjective refraction (best-corrected visual

TABLE 1 **Mean 25-item National Eye Institute Visual Function Questionnaire (NEI-VFQ-25) scores (standard error) by age and sex (Extension Blue Mountains Eye Study population)**

	(Age sex-adjusted)			(Sex age-adjusted)	
NEI-VFQ-25 subscale	50–59 years (n = 449)	60–69 years (n = 295)	≥70 years (n = 132)	Men (n = 392)	Women (n = 500)
General health	65.3 (1.1)	65.9 (1.4)	56.9 (2.0)*†	63.2 (1.3)	62.2 (1.1)
General vision	76.8 (0.7)	79.3 (0.8)*	73.1 (1.2)†	76.6 (0.8)	76.2 (0.7)
Ocular pain	86.7 (0.8)	88.1 (0.9)	85.5 (1.4)	87.9 (0.9)	85.6 (0.8)‡
Near vision	86.5 (0.7)	90.4 (0.8)*	86.4 (1.2)†	87.0 (0.7)	88.5 (0.7)
Distance vision	91.7 (0.6)	92.8 (0.7)	88.1 (1.0)*†	91.8 (0.6)	89.9 (0.6)‡
Social function	98.2 (0.4)	98.9 (0.4)	97.3 (0.7)†	97.7 (0.4)	98.7 (0.4)
Mental health	88.4 (0.7)	91.4 (0.8)*	88.7 (1.2)	89.3 (0.8)	89.7 (0.7)
Role difficulty	88.8 (0.8)	90.5 (1.0)	86.9 (1.6)†	89.4 (1.0)	88.1 (0.9)
Dependency	98.1 (0.3)	99.2 (0.4)*	97.7 (0.6)†	98.1 (0.4)	98.5 (0.4)
Driving	91.7 (0.6)	92.1 (0.8)	85.7 (1.4)*†	91.6 (0.7)	88.1 (0.7)‡
Colour vision	97.3 (0.5)	99.1 (0.6)*	96.4 (0.8)†	97.0 (0.5)	98.2 (0.5)
Peripheral vision	93.6 (0.7)	95.1 (0.9)	91.2 (1.3)†	93.0 (0.8)	93.6 (0.7)
Composite score	88.5 (0.4)	90.2 (0.5)*	86.2 (0.8)*†	88.5 (0.5)	88.1 (0.4)

*Significantly different ($p \leq 0.05$) from participants aged 50–59 years; †Significantly different ($p \leq 0.05$) from participants aged 60–69 years; Significantly different ($p \leq 0.05$) from men.

acuity).[15] Prior to their examination, participants were sent a detailed questionnaire that included the NEI-VFQ-25. Participants were asked to bring the questionnaire booklets to their examination or to return it by reply-paid mail.

Definitions

Visual impairment was defined as visual acuity (VA) <6/12. Correctable visual impairment was defined as visual impairment at presentation that improved to no impairment (VA ≥ 6/12) after subjective refraction, and non-correctable visual impairment was defined as visual impairment that persisted after subjective refraction. Unilateral and bilateral visual impairment was defined using the worse and better eyes, respectively. Mild visual impairment was defined as visual acuity <6/12 but ≥6/24, moderate as <6/24 but ≥6/60, and severe as <6/60.

Statistical Analysis

The Statistical Analysis System (SAS 8.2 for Windows; SAS Institute Inc., Cary, NC) was used for analyses. Generalised linear models using analysis of covariance were used to calculate age- and sex-adjusted scores. These methods have shown great resilience for data with skewed deviations. Age- and sex-adjusted VFQ scores (mean ± standard error) were compared among subjects with no, unilateral, or bilateral visual impairment, as well as among those with no, correctable, or non-correctable visual impairment.

RESULTS

Complete data were available for 892 (76.0%) of the 1174 Extension BMES participants (mean age 60.8 years). There were no significant differences in age, sex, or vision-status between NEI-VFQ-25 responders and non-responders (data not shown).

Age and Sex

Men had significantly better scores than women in three subscales but there were no significant gender differences in overall composite scores (men 88.5 ± 0.5; women 88.1 ± 0.4) (Table 1). Persons aged 60–69 years had better NEI-VFQ-25 profiles (composite score 90.2 ± 0.5) than persons aged 50–59 years (88.5 ± 0.4) or aged ≥70 years (86.2 ± 0.8).

Visual Impairment

Of those with complete data sets the prevalence of presenting bilateral visual impairment, as defined using the better eye, was 4.5%, while that of unilateral visual impairment, as defined by the worse eye, was 13.0%. Correctable visual impairment was far more common,

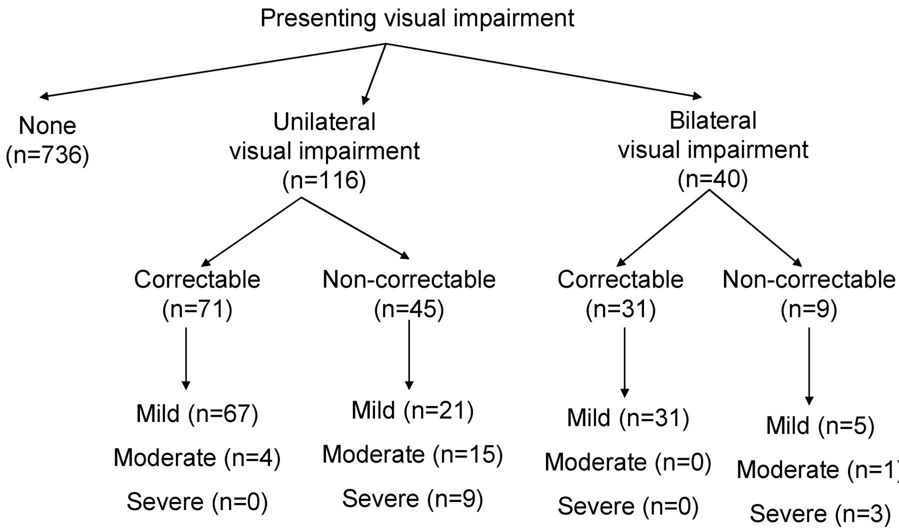

FIGURE 1 **Distribution of Extension Blue Mountains Eye Study population by presenting visual impairment.**

accounting for more than half of presenting unilateral (61.2%) and more than three-quarters of presenting bilateral (77.5%) impairment, but was generally associated with a milder level of impairment than non-correctable impairment (Fig. 1). Similarly, persons with bilateral visual impairment tended to have proportionately more severe levels of impairment than persons with unilateral visual impairment.

Presenting bilateral visual impairment was associated with significantly poorer functioning (composite score 77.1 ± standard error 1.4) than unilateral (87.5 ± 0.8) or no visual impairment (89.4 ± 0.3) (Table 2). The impact of bilateral visual impairment was principally from non-correctable impairment (49.2 ± 2.6), with a much more modest although measurable impact from impairment due to refractive errors (85.3 ± 1.4, Fig. 2). Non-correctable bilateral impairment significantly affected all NEI-VFQ-25 subscales ($p \leq 0.05$) while correctable impairment significantly affected eight dimensions, including the composite score ($p \leq 0.05$, Table 2).

Persons with non-correctable unilateral impairment (composite score 85.3 ± standard error 1.1) had

TABLE 2 **Age- and sex-adjusted mean 25-item National Eye Institute Visual Function Questionnaire (NEI-VFQ-25) scores (standard error) by visual impairment status (Extension Blue Mountains Eye Study population)**

	Presenting visual impairment			Unilateral visual impairment		Bilateral visual impairment	
NEI-VFQ-25 subscale	None (*n* = 736)	Unilateral (*n* = 116)	Bilateral (*n* = 40)	Correctable (*n* = 71)	Non-correctable (*n* = 45)	Correctable (*n* = 31)	Non-correctable (*n* = 9)
General health	64.4 (0.9)	62.8 (2.2)	63.5 (3.7)	65.4 (2.9)	62.2 (3.5)	68.5 (4.3)	49.1 (7.8)*§
General vision	78.4 (0.5)	73.6 (1.3)*	60.6 (2.2)*†	78.4 (1.6)	70.1 (1.9)*‡	69.2 (2.4)*	30.7 (4.4)*§
Ocular pain	86.8 (0.6)	88.2 (1.5)	81.8 (2.5)*†	90.1 (2.0)	86.2 (2.4)	84.7 (2.9)	72.6 (5.3)*§
Near vision	88.9 (0.5)	86.7 (1.3)	71.7 (2.1)*†	90.7 (1.6)	83.3 (1.9)*‡	80.8 (2.3)*	40.1 (4.3)*§
Distance vision	92.3 (0.4)	90.3 (1.1)	76.9 (1.9)*†	91.5 (1.3)	88.9 (1.6)*	88.1 (1.9)*	38.2 (3.4)*§
Social function	99.0 (0.3)	98.2 (0.7)	88.0 (1.2)*†	99.5 (0.7)	97.3 (0.8)*‡	97.5 (1.2)	55.3 (2.1)*§
Mental health	90.4 (0.5)	87.2 (1.3)*	74.6 (2.2)*†	91.5 (1.6)	81.8 (1.9)*‡	82.8 (2.4)*	46.4 (4.4)*§
Role difficulty	90.1 (0.6)	87.3 (1.6)	73.8 (2.8)*†	90.5 (2.1)	84.5 (2.6)*	82.9 (3.1)*	44.6 (5.7)*§
Dependency	99.0 (0.3)	97.5 (0.7)*	87.9 (1.1)*†	98.6 (0.7)	96.9 (0.8)*	94.5 (1.2)*	66.4 (2.2)*§
Driving	91.9 (0.5)	89.2 (1.3)*	77.2 (2.5)*†	88.9 (1.5)	88.6 (2.0)	91.0 (2.5)	24.1 (4.9)*§
Colour vision	98.2 (0.3)	98.0 (0.9)	91.6 (1.5)*†	98.1 (1.1)	98.1 (1.4)	98.9 (1.7)	66.2 (3.0)*§
Peripheral vision	94.7 (0.5)	92.3 (1.3)	80.2 (2.3)*†	95.5 (1.7)	88.0 (2.0)*‡	88.9 (2.5)*	50.1 (4.5)*§
Composite score	89.4 (0.3)	87.5 (0.8)*	77.1 (1.4)*†	90.0 (0.9)	85.3 (1.1)*‡	85.3 (1.4)*	49.2 (2.6)*§

*Significantly different ($p \leq 0.05$) from participants with no visual impairment; †Significantly different ($p \leq 0.05$) from participants with unilateral presenting visual impairment; ‡Significantly different ($p \leq 0.05$) from participants with correctable unilateral visual impairment; §Significantly different ($p \leq 0.05$) from participants with correctable bilateral visual impairment.

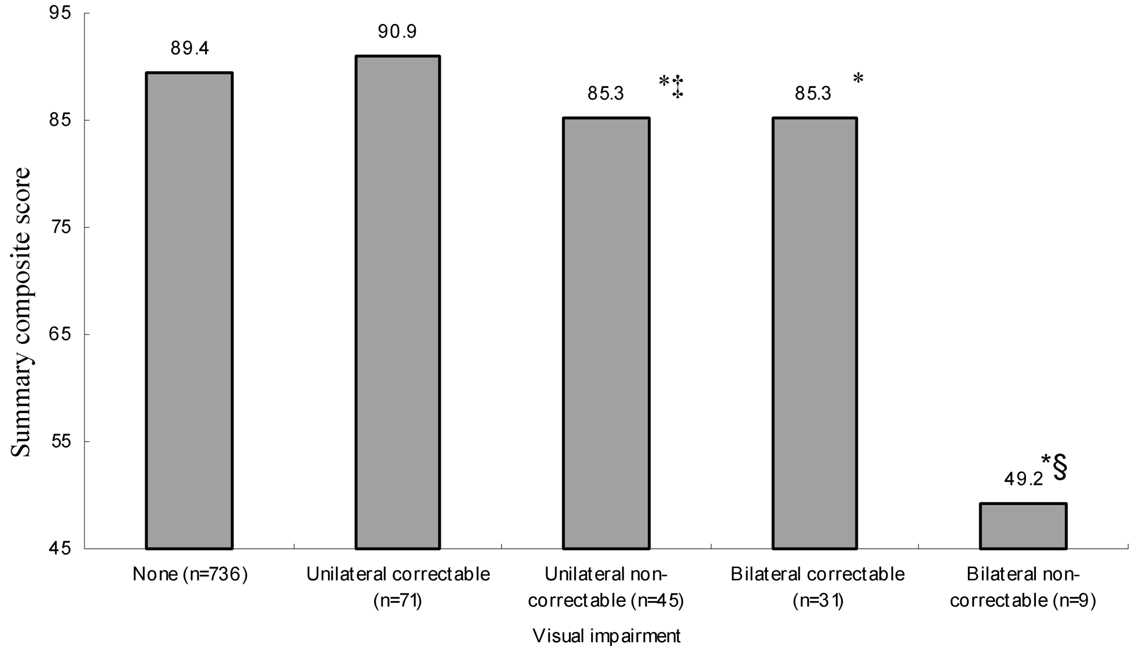

FIGURE 2 **Age- and sex-adjusted mean summary composite scores on the 25-item National Eye Institute Visual Function Questionnaire (NEI-VFQ-25) by visual impairment status (Extension Blue Mountains Eye Study population). *Significantly different ($p \leq 0.05$) from participants with no visual impairment; ‡Significantly different ($p \leq 0.05$) from participants with correctable unilateral visual impairment; §Significantly different ($p \leq 0.05$) from participants with correctable bilateral visual impairment.**

significantly poorer visual functioning than persons without impairment (90.0 ± 0.9, Fig. 2). Significantly lower mean scores were also obtained in eight other NEI-VFQ-25 subscales (Table 2). Correctable unilateral visual impairment did not significantly affect NEI-VFQ-25 scores. Similar results were also obtained after excluding cases of unilateral impairment due to amblyopia (n = 16, data not shown).

Increasing levels of impairment were associated with significantly poorer levels of functioning (age- and sex-adjusted p_{trend}<0.0001; Fig. 3) as demonstrated by the decreasing composite scores with increasing levels of

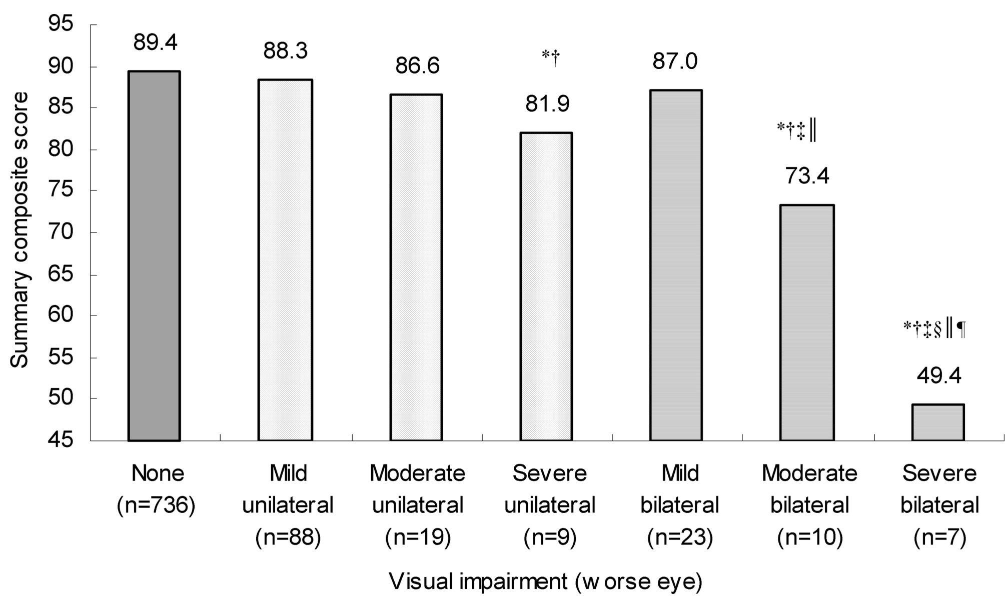

FIGURE 3 **Age- and sex-adjusted mean summary composite scores on the 25-item National Eye Institute Visual Function Questionnaire (NEI-VFQ-25) by level of visual impairment, stratified according to worse eye (Extension Blue Mountains Eye Study population). *Significantly different ($p \leq 0.05$) from participants with no visual impairment; †Significantly different ($p \leq 0.05$) from participants with mild unilateral visual impairment; ‡Significantly different ($p \leq 0.05$) from participants with moderate unilateral visual impairment; §Significantly different ($p \leq 0.05$) from participants with severe unilateral visual impairment; ‖Significantly different ($p \leq 0.05$) from participants with mild bilateral visual impairment; ¶Significantly different ($p \leq 0.05$) from participants with moderate bilateral visual impairment.**

impairment: no impairment (composite score 89.4 ± standard error 0.3), mild unilateral impairment (88.3 ± 0.9), moderate unilateral impairment (86.6 ± 1.8), severe unilateral impairment (81.9 ± 2.7), mild bilateral impairment (87.0 ± 1.7), moderate bilateral impairment (73.4 ± 2.5), and severe bilateral impairment (49.4 ± 3.0).

DISCUSSION

In this older population, poorer vision-related functioning and well-being were associated with visual impairment. The impact of bilateral visual impairment, as defined by visual acuity in the better eye, was greater than that of unilateral impairment, as defined by the worse eye. Persons with bilateral visual impairment also tended to have proportionately more severe levels of impairment than persons with unilateral visual impairment. In both cases, the impact was predominantly due to non-correctable impairment. Visual impairment from refractive errors was more frequent but generally led to milder levels of impairment, with bilateral correctable visual impairment having a small, though measurable, impact on visual functioning.

Bilateral visual impairment due to eye pathology was associated with a significant decline in all vision-related NEI-VFQ-25 subscale scores, consistent with previous population-based[10,11] and clinic-based studies.[2,16] Bilateral visual impairment due to refractive errors also had an impact on most NEI-VFQ-25 subscale scores, but to a lesser extent than impairment due to eye conditions as previously reported by Broman et al.[11] The ability of the NEI-VFQ-25 to differentiate impact between persons with correctable or non-correctable bilateral visual impairment and those without any impairment was demonstrated in our study. This was also demonstrated by Cole et al., who noted only relatively minor decreases in visual acuity in their study population.[17]

The impact of bilateral visual impairment has also been shown to be much greater than that of unilateral impairment. The impact of unilateral and bilateral visual impairment in our study was comparable to both the clinic-based Age-Related Eye Disease Study (AREDS)[16] and the population-based Proyecto VER[11] reports. In the AREDS report, persons with unilateral (n = 1041) and bilateral (n = 1705) visual impairment had significantly poorer scores than persons without visual impairment (n = 1078), either in six or in all the dimensions, respectively.[16] Similarly, presenting monocular impairment was associated with significantly poorer scores in all subscales.[11] Although there were slight differences in the dimensions affected in each study, our findings further support evidence that certain NEI-VFQ-25 subscales (e.g., general health and vision; near and distance vision; driving; role difficulty; dependency) are more sensitive to changes in central visual acuity than are other subscales (e.g., colour vision, ocular pain).[10,11,17,18]

The greater impact of non-correctable over correctable visual impairment and of bilateral over unilateral visual impairment could be argued to be the direct result of the actual visual impairment levels within these groups. For example, since there were proportionately more severe levels of visual impairment within the non-correctable and bilateral visual impairment groups, respectively, than among persons with correctable and unilateral visual impairment, greater impacts were seen in the former group. However, it could also be argued that persons with bilateral visual impairment would be likely to have more severe disease processes than those with unilateral visual impairment, contributing to its greater impacts.

Although NEI-VFQ-25 scores generally decrease with age,[10,12] this trend of association was not as strong in our older population-based sample. Persons aged 60–69 years had better NEI-VFQ-25 profiles than the comparatively "younger" or "older" portions of this older population. In the AREDS study,[16] the scores on all NEI-VFQ-25 subscales with the exception of ocular pain declined significantly with increasing age, although the age groups compared were slightly different (<70, 70–75, >75 years). In that study, although men had significantly better "ocular pain" and "driving" scores than women, poorer "colour vision" scores were reported. Other non-ocular factors that have been reported to influence NEI-VFQ-25 profiles include ethnicity,[16] income,[12] and individual factors such as coping or adaptation mechanisms.[14,18] Our study population was predominately white, hence the comparison of NEI-VFQ-25 profiles by ethnicity was not assessed.

One limitation of our study is the relatively small number of persons with non-correctable visual impairment, which did not permit comparison of NEI-VFQ-25 scores among different underlying causes of visual impairment. Although there is consensus that the impacts of cataract are largely due to its effect on acuity alone,[10,11] there appears to be debate on the impacts from other eye conditions. Broman et al.[11] reported that the impacts of glaucoma and diabetic retinopathy were from other effects, apart from acuity, but Klein et al.[10] reported, after controlling for visual acuity, that there was a minimal effect from more severe diabetic retinopathy on NEI-VFQ-25 composite scores. Another limitation of our study is that other aspects of visual functioning (e.g., contrast sensitivity, peripheral visual field, and stereo-acuity)[17,19,20] were not assessed.

In conclusion, unilateral and bilateral visual impairment due to eye pathology dramatically reduced vision-related functioning ability in older persons, as indicated by the NEI-VFQ-25 subscale and summary composite scores, and the impact increased with greater levels of impairment. Although the impact from bilateral visual impairment due to refractive errors was modest, the relatively higher prevalence of correctable visual impairment will inevitably increase its overall burden. Regular use of eye care services by older persons may help to reduce this burden and improve their ability to live independently.

ACKNOWLEDGEMENTS

The National Eye Institute 25-item Visual Function Questionnaire (NEI-VFQ-25) was developed by RAND and funded by the National Eye Institute. This study was supported by the Australian National Health & Medical Research Council (Grant Nos. 974159, 991407) and the Westmead Millennium and Save Sight Institutes, University of Sydney.

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