Health Burden Associated with Visual Impairment in Singapore

The Singapore Epidemiology of Eye Disease Study

Xingzhi Wang, BSc,[1] *Ecosse Lamoureux, PhD,*[2,3,4] *Yingfeng Zheng, MD,*[2,5] *Marcus Ang, FAMS, FRCSEd,*[2] *Tien Yin Wong, MD, PhD,*[1,2,5] *Nan Luo, PhD*[1]

Objective: To assess the impact of visual impairment (VI) on health-related quality of life and to compare the health burden of VI and other health conditions in Singapore.

Design: Population-based cross-sectional study.

Participants: We studied the 10 009 adults (3353 Chinese, 3397 Indians, and 3259 Malays) who underwent a comprehensive eye assessment and completed the European Quality of Life-5 Dimensions (EQ-5D) questionnaire in the Singapore Epidemiology of Eye Disease Study.

Methods: We estimated the effects of VI, obesity, hypertension, diabetes, and hyperlipidemia on the EQ-5D index score using linear regression models and the association between VI and self-reported EQ-5D health problems using logistic regression models. We compared prevalence-based quality-adjusted life-year (QALY) loss associated with VI and other health conditions. For each condition, QALY loss was calculated for 100 000 persons in 1 year using associated reduction in EQ-5D index score estimated in regression analysis as disutility.

Main Outcome Measures: The EQ-5D index score and annual QALY loss.

Results: The EQ-5D index score decreased with increasing VI severity in all 3 ethnicities. For example, after adjusting for sociodemographic characteristics, the difference in EQ-5D index score between adults with bilateral severe VI and those without VI was −0.044 (95% confidence interval [CI], −0.089 to 0.001) in Chinese, −0.127 (95% CI, −0.237 to −0.017) in Indians, and −0.085 (95% CI, −0.148 to −0.022) in Malays. In all 3 ethnicities, VI was associated with reporting of problems in mobility (e.g., odds ratio [OR], 3.69 for Chinese with bilateral severe VI; 95% CI, 1.21−12.13) and usual activities (e.g., OR, 6.51 for Chinese with bilateral severe VI; 95% CI, 1.59−26.58). In Indians, VI was also associated with anxiety or depression (e.g., OR, 2.68 for bilateral severe VI; 95% CI, 1.11−6.50). The annual QALY loss associated with VI was 511.8 in Chinese, 608.8 in Indians, and 706.7 in Malays, greater than that associated with other health conditions examined in this study.

Conclusions: Visual impairment is associated with substantial health burden among Asians in Singapore. The relatively high burden of VI highlights the importance of VI prevention. The ethnic difference exhibited in this burden warrants further study. *Ophthalmology 2014;■:1−6 © 2014 by the American Academy of Ophthalmology.*

**Supplemental material is available at www.aaojournal.org.*

Visual impairment (VI) is an important public health issue in Asia.[1] In Southeast Asia alone, approximately 45 million people have VI, among whom 12 million are blind.[2,3] With the aging of the population, the burden of VI is anticipated to increase.[4,5] Previous studies have shown that VI not only affects people's visual status, but also has an impact on people's functioning and well-being.[6−8] Hence, apart from visual acuity (VA), health-related quality of life (HRQOL) also should be measured to achieve a comprehensive assessment of the impact of VI on patients.

Both vision-specific and generic HRQOL instruments are used to measure the health burden of VI. Vision-specific quality of life instruments such as the Vision Function Index questionnaire[9] are more sensitive to vision problems than generic instruments such as the European Quality of Life-5 Dimensions questionnaire (EQ-5D).[10,11] However, vision-specific quality of life instruments cannot generate a utility-based index score for the calculation of quality-adjusted life-years (QALYs) or comparison of the health burden associated with vision problems and other health conditions. The health burden of VI has been estimated using the EQ-5D in several Western and Eastern populations[11−15]; however, the sample sizes of those studies are relatively small, and therefore the findings in those studies may not be generalizable to Asians in Singapore. In this study, we measured the impact of VI on generic HRQOL and compared it with commonly seen health conditions among the 3 major ethnicities in Singapore.

Methods

Study Population

In this study, we used data from the Singapore Epidemiology of Eye Disease (SEED) study comprising 3 population-based eye

ISSN 0161-6420/14/$ - see front matter
http://dx.doi.org/10.1016/j.ophtha.2014.03.017

studies: the Singapore Chinese Eye Study, the Singapore Indian Eye Study, and the Singapore Malay Eye Study. The 3 studies have been described in detail previously.[16,17] In brief, an age-stratified random sampling was used to select ethnic Chinese, Indians, and Malays 40 to 80 years of age living in Singapore. The overall response rate was 75.6%: 72.8% for Chinese, 75.6% for Indians, and 78.7% for Malays. The SEED study adhered to the principles of Declaration of Helsinki, and ethical approval was obtained from the Singapore Eye Research Institute Institutional Review Board.

Health-Related Quality of Life Measure

We used the EQ-5D to assess generic HRQOL. The EQ-5D contains 5 dimensions: mobility, self-care, usual activities, pain or discomfort, and anxiety or depression. Participants rated their health status in those dimensions on the day of the survey at 1 of 3 levels: no problems, some problems, or extreme problems. To measure the usefulness or value of the health status of the participants, we used their responses to the 5 dimensions to calculate an index score ranging from −0.59 for the worst health state to 1.00 for perfect health.[18] In this interval scale used by the EQ-5D, a score of 0 means the value of the corresponding health states is as bad as death, and negative scores indicate the corresponding health states are worse than death. In the 3 studies, trained research assistants conducted a face-to-face interview in English, Chinese, Tamil, or Malay, depending on the participant's preference. Previous studies tested the validity and reliability of the EQ-5D questionnaire in English- and Chinese-speaking Asian patients with rheumatic diseases in Singapore[19,20] as well as in local Malay- and Tamil-speaking patients.[21] The EQ-5D demonstrated satisfactory validity and reliability in both local general and patient populations,[21–24] including persons with vision problems.[25,26]

Definitions of Visual Impairment

In all 3 eye studies, participants underwent extensive visual examinations, including VA testing and a detailed clinical slit-lamp examination. We measured presenting VA for each participant with a logarithm of the minimum angle of resolution chart (Lighthouse International, New York, NY) at a distance of 4 m, with the participants wearing their habitual optical correction (e.g., spectacles or lenses). If the participants could read no number at 4 m, they moved to 3, 2, or 1 m, consecutively. If they could read no number on the chart, we assessed the VA as counting fingers, hand movements, light perception, or no light perception.

We classified VI as unilateral and bilateral VI and as both mild or moderate and severe. We defined mild or moderate VI as VA worse than 20/40 but better than 20/200 (logarithm of the minimum angle of resolution equivalent, >0.30 to <1.00) and severe VI as VA of 20/200 or worse (logarithm of the minimum angle of resolution equivalent, ≥1.00).[27] We defined unilateral VI based on the VA of the better-seeing eye and classified the severity of bilateral VI into 6 categories[28]: (1) normal vision in both eyes, (2) normal vision in 1 eye and mild or moderate VI in the other, (3) normal vision in 1 eye and severe VI in the other eye, (4) mild or moderate vision impairment in both eyes, (5) severe VI in 1 eye and mild or moderate VI in the other, and (6) severe VI in both eyes.

Other Health Conditions

We determined the presence or absence of 4 health conditions, including obesity, hypertension, diabetes, and hyperlipidemia, for each participant. We defined obesity as body mass index of 30 kg/m^2 or more; diabetes as random glucose level of 200 mg/dl (11.1 mmol/l) or more, use of diabetic medication, or self-report of physician diagnosis; hyperlipidemia as a total cholesterol level of 239.4 mg/dl (6.2 mmol/l) or more or use of lipid-lowering drugs; and hypertension as systolic blood pressure (BP) of 140 mmHg or more, diastolic BP of 90 mmHg or more, or current use of antihypertensive medications. We measured BP twice (5 minutes apart). If there was more than a 10-mmHg (systolic) and 5-mmHg (diastolic) difference in the BP measures, we performed a third measurement and considered the BP as the mean between the 2 closest readings.

Statistical Analysis

We performed both univariate and multivariate analyses to examine the association between the EQ-5D index score and VI. First, we used analysis of variance and chi-square tests to compare sociodemographic characteristics across the 3 ethnicities and the EQ-5D index score across different subgroups of individuals with and without unilateral or bilateral VI. Second, we used multivariate linear regression models to examine the effect of unilateral or bilateral VI on the EQ-5D index score by controlling for sociodemographic factors that were found to be associated with HRQOL in a previous study.[14] Because the distribution of the EQ-5D index score was skewed, we used the robust standard error estimator[29] in the multivariate linear regression analysis. To detect the differential effect of VI across ethnicities, we performed a pooled analysis with cross-product interaction terms between VI and ethnicity being added to the regression models. Third, we used binary logistic regression analysis to examine the association between the presence of EQ-5D health problems and the severities of unilateral or bilateral VI. In this analysis, we coded responses to each EQ-5D item into a binary variable (with problems or without problems) and analyzed it in a separate model. Finally, we simultaneously estimated the effects of VI and other health conditions (obesity, hypertension, diabetes, and hyperlipidemia) on the EQ-5D index score in a multivariate linear regression model. In this model, we classified VI into 2 categories (with VI or without VI) according to the VA of the better-seeing eye. To assess the total burden of VI and the other health conditions at the population level, we calculated the annual QALY loss per 100 000 persons for each condition using the formula below:

$$\text{Annual QALY loss} = \text{disutility score} \times 1 \text{ year} \times 100\,000 \times \text{prevalence rate},$$

where disutility is the regression coefficient for the condition in the above-mentioned model and the prevalence rate is the observed proportion of cases with the condition in the SEED study. The QALY is an outcomes measure calculated as years a person lives (life-years) weighted by the person's quality of life measured by a utility-based tool such as the EQ-5D.[30,31] For example, 1 year in perfect health is 1 QALY, whereas 2 years in a health state of 0.75 is 1.5 QALYs. We conducted all analyses for each ethnicity (Chinese, Indian, and Malay) separately using SAS software version 9.2 (SAS Inc., Cary, NC) at a significance level of 0.05.

Results

After excluding 3 Indian and 21 Malay participants with missing responses to EQ-5D, 3353 Chinese, 3397 Indian, and 3259 Malay participants were included in the study. The sociodemographic and health characteristics of each ethnic group are described in Table 1. The mean ± standard deviation ages of Chinese, Indian, and Malay subjects were 59.7±9.9, 57.8±10.1, and 58.7±11.0 years, respectively. The proportion of males was 49.6%, 50.1%, and 48.8% among Chinese, Indians, and Malays, respectively. Significant differences across the 3 ethnicities existed for all sociodemographic and health characteristics, except sex