Marital status and its relationship with the risk and pattern of visual impairment in a multi-ethnic Asian population

Yingfeng Zheng1,2, Ecosse L. Lamoureux1,3, Peggy P.C. Chiang1, Ainur Rahman Anuar1,4, Tien Y. Wong1,3,5,6

1Singapore Eye Research Institute, Singapore National Eye Centre, 11 Third Hospital Ave, #05-00, Singapore 168751, Singapore
2State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou, China
3Centre for Eye Research Australia, Royal Victorian Eye and Ear Hospital, University of Melbourne, Melbourne, Australia
4Department of Ophthalmology, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia
5Department of Ophthalmology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore
6Department of Epidemiology and Public Health, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore

Address correspondence to Tien Y. Wong, E-mail: ophwty@nus.edu.sg

ABSTRACT

Background To examine whether marital status is a significant determinant of visual impairment (VI) in urban multi-ethnic Asian population.

Methods We conducted a population-based study of Singapore-resident ethnic Malays, Indians and Chinese aged ≥ 40 years. Ophthalmic examination included the assessment of presenting and best-corrected visual acuity (PVA and BCVA) using standardized procedures. Information regarding marital status and socioeconomic status were obtained from an interviewer-administered questionnaire.

Results Among the 10,033 participants, 7,756 (77.3%) were married; 589 (5.9%) were single; 407 (4.1%) were separated and 1,265 (12.6%) were widowed. Being single (never married) or widowed were significantly associated with best-corrected VI (BCVA, 20/40) and presenting VI (PVA, 20/40) (odds ratios: 1.37–1.59) compared with married people even after adjustment for age, sex and socioeconomic status. A marginal prediction model showed that the negative effect of unmarried status on VI increased with age and was stronger among Malays and Indians, but the influence did not vary with gender, educational level and diabetic status.

Conclusions Unmarried status is associated with VI, particularly among elderly Malays and Indians. Our findings suggest that single and widowed adults may benefit from specific social support and eye care programmes.

Keywords Asia, blindness, epidemiology, living alone, marital status, population-based study, visual impairment

Introduction

Visual impairment (VI) is one of the most devastating morbidities affecting millions of individuals worldwide with serious implications on the quality of life.1 Previous population-based studies have identified a diverse array of risk factors associated with VI.2,3 Most of these risk factors have focused on sociodemographic (e.g. age and educational level), lifestyle (e.g. diet and smoking) and medical (e.g. diabetes), but few have specifically addressed the influence of marital status.2,3

An adverse social network factor such as unmarried status, either single, divorced or widowed, is known to be associated with an increased risk of a range of systemic diseases (e.g. cardiovascular diseases) and mortality.4–6 It is likely that patients may not notice any subtle changes in health when living alone, whereas those with a spouse may get noticed earlier. Positive support from spouse may also have an important role in health-care-seeking behaviour and decision. Nevertheless, very limited data are available on the impact of marital status on VI.7–9 Furthermore, the adverse influences of unmarried status may vary across different...
sociocultural environments and socioeconomic status areas. A better understanding of the inter-relationship of marital status, demographic and medical risk factors may help the design and implementation of preventative interventions at the community level.

The pressures of rapid modernization in urban Asia have resulted in a higher emphasis for career development, and wealth creation, resulting in a trend towards later marriage or no marriage among Asians. Additionally, most of the Asian countries have a culture against cohabitation (i.e. living with a partner before or without marriage). This is in contrast to western countries where the high rate of cohabitation offsets the high prevalence of later marriage and divorce.

In the present study, we examined the associations of marital status with VI among a multi-ethnic sample of Chinese, Malays and Indians (40 years of age and older) residing in Singapore. We hypothesized that unmarried status (single, divorced or widowed) is an independent risk factor for VI and that the interactive effect of this factor varies with gender, ethnicity, socioeconomic status and medical factors (e.g. diabetes).

**Methods**

**Study population**

The Singapore Epidemiology of Eye Disease (SEED) Study is a population-based, cross-sectional study of 3353 Chinese, 3280 Malay and 3400 Indian adults aged 40 and older. This sample size would provide sufficient power to detect ethnic differences in the prevalence of major sight-threatening diseases. Details of the sample size estimation have been published previously. The study was conducted in the south-western part of Singapore between 2004 and 2011. Using an age-stratified random sampling strategy, 6752 Chinese, 5600 Malay and 6350 Indian subjects were selected from the registry of the Ministry of Home Affairs and 4605 Chinese, 4168 Malay and 4497 Indians were deemed eligible to participate. The ’ineligible’ persons were those who had moved out from the residential address, had not lived there in the past 6 months and were deceased or terminally ill. In each ethnic cohort, the non-participants on average were slightly older than the participants ($P < 0.001$), and there were no significant gender differences between the two groups. The study adhered to the Declaration of Helsinki and ethics approval was obtained from the Singapore Eye Research Institute (SERI) Institutional Review Board. All examinations were carried out at SERI.

**Visual acuity testing and definition of VI**

Presenting monocular visual acuity (PVA) was measured separately using a logarithm of the minimum angle of resolution (LogMAR) chart (Lighthouse International, New York, USA) at a distance of 4 m and recorded as the smallest line read with one or no errors. Best-corrected visual acuity (BCVA) was measured by certified study optometrists after correcting for any refractive errors. When no number on the chart could be read at 4 m, the participant was instructed to move to 3, 2 or 1 m, consecutively. When no number could be read at all, visual acuity (VA) was recorded as counting fingers, hand movements, perception of light or no perception of light. VI was defined using the US definition, i.e. VA worse than 20/40 (LogMAR >0.30) in the better seeing eye. Diabetes was defined as self-report of a previous diagnosis of the disease by a doctor, use of diabetic medication or haemoglobin A1c (HbA1c) of 6.5% or greater (as recommended by the American Diabetes Association).

**Marital status and other information**

A detailed interviewer-administered questionnaire was used to collect information regarding socioeconomic status (e.g. education, income and housing type) living arrangement (living with others and living alone), marital status (married, single, divorced and widowed) and medical history of eye diseases.

**Statistical analysis**

All statistical analyses were performed using the STATA version 11.0 (Stata Corp, College Station, TX, USA). A logistic regression model was used to assess the risk factors associated with the presence of VI. Adjusted odds ratios (OR) were obtained from multivariate logistic regression models. Adjusted prevalence estimates were obtained from marginal prediction models. A $P$ value of <0.05 was defined to indicate statistical significance.

**Results**

There were 3353 Chinese, 3280 Malay and 3400 Indian participants, with a participation rate of 72.8, 78.7 and 75.6%, respectively. Table 1 shows the characteristics of the study population by marital status. Among Chinese men, 87.4% were married, 7.6% were single, 2.2% divorced and 2.8% widowed. These figures were 71.9, 10.2, 3.0 and 14.9% for Chinese women. Among Malay men, 85.5% of men were married, 5.2% were single, 3.8% divorced and 5.1% were widowed. These figures were 63.6, 3.5, 6.9 and 25.5% for Malay women. Among the Indian men, 89.6% of men were married, 4.1% were single, 3.5% divorced and 2.7% were widowed. These figures were 66.6, 23.8, 5.0 and 4.7% for Indian women.
Single persons were generally more likely to have lower BMI, higher educational level, higher income and lower prevalence of diabetes and hypertension compared with the whole population. In contrast, widowed persons were more likely to have a lower education level, lower income and higher prevalence of diabetes and hypertension compared with the whole population.

Table 2 shows the associations of marital status with presenting VI (PVI) and best-corrected VI (BCVI). In univariate analysis, being single or widowed was more likely to have higher odds of VI. The effects remained significant in multivariate analysis after adjusting for the influences of age, gender, socioeconomic status and presence of diabetes. In supplementary analysis stratified by ethnicity, the significant association of being single with VI was persistent in ethnic Malays and Indians, but not in ethnic Chinese. The significant association of being widowed with VI was persistent in ethnic Malays, but not in ethnic Chinese and Indians.

In stratified analysis, we tested separately the influence of marital status on the prevalence of VI across different gender, ethnicity, socioeconomic and diabetic categories, while controlling for other key variables. Using Stata’s ‘margins’ commands, we found that the effects of being single or widowed on VI became apparent after the age of 60 (Fig. 1 and Supplementary data, Fig. 1). The prevalence of VI did not vary significantly across different marital categories in Chinese. In contrast, single or widowed Malays were more likely to have VI compared with married Malays, and single or widowed Indians were more likely to have VI compared with married Indians (Fig. 1 and Supplementary data, Fig. 1). The influence of marital status on VI did not vary with gender (Fig. 1), educational level (Supplementary data, Fig. 2) and diabetic status (Supplementary data, Fig. 3).

The major causes of VI were similar across different marital categories. Overall, cataract remained the major cause of BCVI, followed by diabetic retinopathy, age-related macular degeneration and other eye diseases (Fig. 2). In addition, the major causes of PVI—cataract and under-corrected refractive error—were similar across different marital categories.

Given that the role of marital status may potentially be confounded by the effect of living arrangement (living alone versus living with others), we tested separately the effect of living alone on VI. In the multivariate regression model

### Table 1 Baseline characteristics of the study participants

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All (N)</th>
<th>Married (N)</th>
<th>Single (N)</th>
<th>Divorced (N)</th>
<th>Widowed (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>3353 (33.5)</td>
<td>2668 (34.4)</td>
<td>300 (50.9)</td>
<td>86 (21.1)</td>
<td>299 (23.6)</td>
</tr>
<tr>
<td>Malays</td>
<td>3280 (32.6)</td>
<td>2431 (31.3)</td>
<td>140 (23.8)</td>
<td>178 (43.7)</td>
<td>517 (40.8)</td>
</tr>
<tr>
<td>Indians</td>
<td>3400 (33.9)</td>
<td>2657 (34.3)</td>
<td>149 (25.3)</td>
<td>143 (35.1)</td>
<td>449 (35.6)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>58.9 (10.4)</td>
<td>57.9 (9.9)</td>
<td>53.7 (8.2)</td>
<td>55.4 (9.2)</td>
<td>68.7 (8.6)</td>
</tr>
<tr>
<td>Gender (female)</td>
<td>5082 (50.7)</td>
<td>3427 (44.2)</td>
<td>312 (53.0)</td>
<td>252 (61.9)</td>
<td>1091 (86.2)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.4 (4.7)</td>
<td>25.4 (4.5)</td>
<td>23.9 (4.9)</td>
<td>25.2 (4.9)</td>
<td>25.9 (5.5)</td>
</tr>
</tbody>
</table>

Data presented are means (standard deviations) or number (%), as appropriate for variable.
after adjusting for age, gender, education, income and diabetic status, living alone was not significantly associated with BCVI and PVI (Supplementary data, Table S1).

Discussion

Main findings of this study

In this population-based study of a multi-ethnic population aged 40 and over living in urban Asia, we showed that both single and widowed status were closely associated with VI, and remained significant and largely unchanged after controlling for main confounders, which includes age, gender, socioeconomic status and diabetes. This risk however, varied with age and ethnicity, with elderly Malays and Indians being particularly susceptible to this ‘marital effect’. Our findings suggest that marital status should be taken into consideration when providing social support and developing health interventions for elderly populations in settings where VI is a concern.

What is already known on this topic

Very few studies have previously addressed the association between unmarried status and VI. Among these, the Los Angeles Latinos Eye Study in the USA\(^9\) found that widowed participants had a highest risk of having VI \(\text{OR} = 2.8\, (95\% \text{ CI}: 1.8–4.4)\), and this was followed by divorced \(\text{OR} = 1.8, 95\% \text{ CI: 1.0–3.1}\) and single participants \(\text{OR} = 1.5, 95\% \text{ CI: 0.6–3.5}\). Another population-based study in Italy also showed that unmarried status was significantly associated with VI \(\text{OR: 2.5\%}\),\(^8\) although masked important differences among sub-categories of marital status (i.e. single, divorced or widowed) were evident. Similarly, a multicentre population-based study in Kenya, Philippines and Bangladesh showed that being married was a protective factor for cataract VI.\(^17\) In contrast, a population-based study in urban Taiwan showed that marital status had no association with VI.\(^18\) One explanation for the lack of effect in Taiwan is that the marital status may not always be a good surrogate for social support across different cultures. Another explanation is that the marital status was crudely classified into two categories (married versus unmarried) in the Taiwan study, resulting in low precision and low statistical power.

What this study adds

Our study provides new evidence that the ‘marital effect’ exists in urban Asia, an area where the social and cultural

### Table 2: Associations of marital status with VI

<table>
<thead>
<tr>
<th></th>
<th>Association with BCVI</th>
<th>Association with PVI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted OR</td>
<td>Multivariate OR (^a)</td>
</tr>
<tr>
<td>All SEED participants</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Married</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Single</td>
<td>2.58 (1.34, 2.98)</td>
<td>1.59 (1.07, 2.50)</td>
</tr>
<tr>
<td>Divorced</td>
<td>0.79 (0.46, 1.37)</td>
<td>0.98 (0.54, 1.76)</td>
</tr>
<tr>
<td>Widowed</td>
<td>4.71 (3.93, 5.65)</td>
<td>1.53 (1.25, 1.88)</td>
</tr>
<tr>
<td>Chinese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Single</td>
<td>0.43 (0.17, 1.07)</td>
<td>0.69 (0.24, 1.99)</td>
</tr>
<tr>
<td>Divorced</td>
<td>0.92 (0.29, 2.96)</td>
<td>1.04 (0.30, 3.63)</td>
</tr>
<tr>
<td>Widowed</td>
<td>4.98 (3.46, 7.18)</td>
<td>1.19 (0.78, 1.81)</td>
</tr>
<tr>
<td>Malays</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Single</td>
<td>0.47 (0.17, 1.30)</td>
<td>2.05 (1.09, 4.88)</td>
</tr>
<tr>
<td>Divorced</td>
<td>0.75 (0.36, 1.57)</td>
<td>1.05 (0.46, 2.39)</td>
</tr>
<tr>
<td>Widowed</td>
<td>4.72 (3.61, 6.16)</td>
<td>1.84 (1.38, 2.47)</td>
</tr>
<tr>
<td>Indians</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Single</td>
<td>1.20 (0.51, 2.78)</td>
<td>2.20 (1.08, 4.95)</td>
</tr>
<tr>
<td>Divorced</td>
<td>0.61 (0.19, 1.95)</td>
<td>0.77 (0.24, 2.53)</td>
</tr>
<tr>
<td>Widowed</td>
<td>3.97 (2.79, 5.64)</td>
<td>1.33 (0.89, 1.97)</td>
</tr>
</tbody>
</table>

\(^{a}\)Multivariate logistic regression models adjusting for age, gender, marital status, education, income and diabetes.
environments are different from those in western countries. This ‘marital effect’ has important public health implications because widowed or single status may exacerbate vision impairment due to the lack of material resources, emotional support, self-fulfilment and information with respect to eye care, vision rehabilitation and healthy lifestyle.19

![Fig. 1](image_url) The predicted prevalence of BCVI by ethnicity and gender.

![Fig. 2](image_url) Main causes of BCVI by marital status.
Understanding why the risk of VI is high in certain sub-categories of marital status may provide clues to prevention. Being married may have different meanings to different people and in different cultures. In our study, living alone was not a risk factor for BCVI/PVI (Supplementary data, Table S1), suggesting that other issues such as security, different financial arrangements and social and emotional support may play a role. It is unlikely that being visually impaired per se can lead to the death of one’s spouse. Instead, widowed individuals may experience greater difficulties and economic pressures that may keep them away from general health and eye care services, and hence, become more vulnerable to VI compared with married participants. In contrast, the causal relationship between single status and VI is not straightforward, since the observed association may be a mixture of causal effect in both directions: VI may represent a barrier to marriage, and unmarried status can exacerbate VI because of the difficulties with self-care. Longitudinal studies are needed to demonstrate causality.

In Singapore’s culture, marriage and having children are intertwined and inseparable. Those with a single status are unlikely to have any children, whereas a stable marriage may be associated with larger numbers of children. Therefore, the marital effect identified in our study also reflects emotional, practical and financial support from both one’s spouse and children.

In our stratified analysis, the influence of unmarried status on VI varied with ethnicity. Specifically, the detrimental effect of being single was only seen in ethnic Malays and Indians, and being widowed was only seen in ethnic Malays (Fig. 1). Conversely, the Chinese appear to be unaffected by the effects of being unmarried; social issues, cultural beliefs and marital attitudes unique to the community may be implicated. Further studies are however needed to substantiate these findings.

**Limitations of this study**

The major limitation of our study is that important confounders such as marital quality, marital history, health behaviour and religious affiliation on VI cannot be addressed. Secondly, the cross-sectional nature of the study also limits the ability to infer a causal relation between marital status and VI. Because of this, it seems worthwhile to conduct prospective studies to determine whether changes in the marital relationships have a direct impact on the onset of eye disease or VI. Thirdly, unmeasured social desirability (i.e. systematic distortion of responses in a certain direction) may have distorted the distributions of the participants’ responses to marital status and may have confused the study’s results. Fourthly, due to the lack of information on the change of marital status over time (for instance, a divorced person may remarry), we could not exclude the possibility of misclassification, which may have biased the results towards the null. Fifthly, we were unable to obtain the amount of health-care benefits one had obtained from his or her family members, and therefore the potential influence of this effect is unclear. Finally, we cannot exclude the possibility of survivor bias, i.e. the individuals with blindness who were single are more likely to die than the ones with blindness who were married. If that was the case, it may have underestimated the relationship between marital status and VI.

Overall, our results suggest that unmarried status is an important predictor for VI among urban Asians, particularly elderly Malays and Indians. Longitudinal studies should continue to examine the detrimental influences of unmarried status on VI and eye diseases as well as the salubrious nature of social ties. Our study has important implications for designing outreach programmes, community-based interventions and health policies for unmarried persons in urban Asia who may be more vulnerable to VI.

**Supplementary data**

Supplementary data are available at the *Journal of Public Health* online.

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**References**