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Original Article

Ophthalmology Section

Visual Impairment among Older Adults in Selangor State of Malaysia: The Grand Challenge Project

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ABSTRACT

Introduction: The increased prevalence of Visual Impairment (VI) in the elderly is in tandem with the increase of its populations in Malaysia.

Aim: This study was aimed to determine the prevalence and risk factors of VI among older adults in Selangor, Malaysia as it is one of the highly populated states in the country.

Materials and Methods: A total of 230 adults aged 60 years and above from the longitudinal study on neuroprotective model for healthy longevity (TUA) took part in this study from August 2018 to May 2019. Information on socio-demographic, smoking status and health condition were obtained through interview. Habitual distance Visual Acuity (VA) was measured using the Early Treatment Diabetic Retinopathy Study (ETDRS) chart. Refractive error was determined using retinoscopy technique followed by subjective refraction. Subjects' height and weight were measured for their Body Mass Index (BMI). Descriptive statistics were used to determine the prevalence of VI and status of refractive error. Pearson correlation was used to determine correlation between household income and VI whereas Kendall's Tau-b was used to determine correlation between age, educational level and smoking status with VI. Multivariate logistic regression was carried out to determine the risk factors of VI.

Results: Analysis was performed on 201 subjects (29 were excluded due to incomplete data) and the mean±SD VA for better eye was 0.23±0.20 logMAR. Overall, emmetropia has the highest percentage (37.3%), followed by hyperopia (34.3%) and myopia (28.4%). This study found that the prevalence of VI among older adults in Selangor was 27.3%. Pearson correlation showed significant correlation between monthly household income with VI. Kendall Tau-b showed a significant correlation between age, educational level and smoking status with VI. Multivariate logistic regression shows significant association between age older than 80-year-old with VI.

Conclusion: The prevalence of VI among the elderly in Selangor was notably high (27.3%) and greater age is associated with VI.

Keywords: Ageing, Elderly, Epidemiology, Prevalence, Refractive error, Vision

INTRODUCTION

The world's elderly population is rising due to decline in fertility and increased longevity. Globally, there is approximately 9% elderly (aged ≥65) in 2019 and is expected to reach 12% in 2030 and 16% in 2050 [1]. The same phenomenon occurred in Malaysia as well. Population census showed an increment of Malaysian elderly from 6.3% in 2017 to 6.5% in 2018 and is expected to reach more than 7.0% in 2020 [2]. With aging of population, prevalence of VI is expected to increase as well [2]. Study in Malaysia also found that the increasing prevalence of VI with age was statistically significant [3,4]. It should be a concern as VI will affect the quality of life, physically, psychologically, environmental, and also social aspects [5-7].

Bourne RRA et al., reported the prevalence of VI worldwide differ according to the severity of VI [8]. Mild VI (VA 6/12 to 6/18 inclusive) was reported to be about 2.57%, moderate and severe VI (VA 6/18 to 3/60 inclusive) 2.95%, and blindness (VA less than 3/60) 0.49% among the world population of 7.33 billion [8]. Bourne RR et al., also found that 78% of the total number of VI was comprised of those aged 50 years and above [8]. Stevens GA et al., reported higher prevalence of VI in developing countries as compared to developed countries [9]. The prevalence of VI and blindness among population in USA aged 40 years and above was 2.14% and 0.68%, respectively [10]. Another developed country, Canada, showed a higher prevalence of VI, which was 5.7% among residents aged 45 to 85-year-old [11]. Study of VI among Singaporean population aged 40 to 80 years revealed a 26.87% low vision and a 1.09% blindness [12]. In Indonesia, it was 18.6% among residents aged 50 years and above [13]. National Eye Survey II (NES II) conducted in 2018 found 5.5% with moderate VI, 0.9% with severe VI and 1.2% blindness among Malaysian elderly population [14]. However, previous study at Sepang reported a 18.9% VI and a 2.9% blindness among residents aged 40 years and above [4].

Previous study on VI in Asia has found that VI could be influenced by demographic and socio-economic factors. Aging, low educational level and household income, systemic diseases including hypertension and diabetes as well as smoking were the common risk factors for VI [11,15-18]. However, there was limited information on risk factors of VI among Malaysian population especially in the elderly population. Moreover, previous study on VI only focused on specific regions in Selangor and unable to demonstrate its prevalence for the whole state of Selangor population [4,19,20]. Therefore, this study was carried out to determine the prevalence and risk factors of VI among older adults in Selangor by using correlation and regression analysis. This study also aimed to determine the status of VA and refractive error among older adults in Selangor.

MATERIALS AND METHODS

This was a cross-sectional study involving Malaysian older adults who participated in the population-based longitudinal study on neuroprotective model for healthy longevity (Towards Useful Aging (TUA) Project) [21]. The TUA study recruited Malaysian older adults aged 60 and above. In this study, 12 places randomly selected from in the state of Selangor (Keramat, Klang, Tanjung Sepat, Kuala Langat, Tanjung Karang, Kuala Selangor, Petaling Jaya, Kelana

Jaya, Sekinchan, Sungai Pelek, Batu 9 Cheras and Kajang). This study was conducted from August 2018 to May 2019. The sample size was determined based on Krejcie and Morgan's sample size calculation [22];

$s=X^2 NP(1-P)\div d^2 (N-1)+X^2P(1-P)$

Where s is the sample size, X is the table value of chi-square for 1 degree of freedom at the desired confidence level (1.96 for 95% confidence level), N is the population size (502200 older adults aged 60 and above in Selangor in 2018 [2], P is the expected prevalence (10.4% VI among residents aged 50 and above in central region of Malaysia (Selangor, Kuala Lumpur and Negeri Sembilan) [14] and d is the degree of accuracy expressed as proportion (0.05). The calculated sample size was added with 20% drop out. Hence, the sample size required was 172. In this study, we recruited 230 participants. However, complete data was only available from 201 subjects, and included in the analysis. The study adhered to the Declaration of Helsinki and was approved by the Medical Research and Ethics Committee of Universiti Kebangsaan Malaysia (UKM1.21.3/244/NN-2018-145). Signed informed consent was obtained from all subjects. The inclusion criteria were older adults aged 60 and above and without documented major psychiatric illnesses or mental disorders. Those participants with a Mini-Mental State Examination (MMSE) score of 14 and below indicating moderately severe or severe cognitive impairment were excluded [21].

Information on socio-demographic (age, races, gender, educational level, monthly household income), smoking status and health condition (hypertension and diabetic status) were obtained during history recording. Habitual distance VA was measured monocularly using the ETDRS chart at 3 m. The testing distance was reduced to 2 m or 1 m if participants failed to identify any letter at 3 m. Refractive error was determined using retinoscopy technique followed by subjective refraction. Subjects' height and weight were measured using Leicester Height Measure (CMS Weighting Equipment, UK) and Tanita HD319 (Tanita Corporation of America, II, USA), respectively. Both height and weight were measured twice and average was used to calculate the BMI.

For analysis purposes, International Classification of Diseases 11th Revision (ICD-11) was used [23]. Based on ICD-11, habitual VA in better eye was used to classify subjects into no VI (VA≤0.30 logMAR), mild VI (0.30 logMAR<VA≤0.48 logMAR), moderate VI (0.48 logMAR<VA≤1.00 logMAR), severe VI (1.00 logMAR<VA≤1.30 logMAR) and blindness (1.30 logMAR<VA≤NLP) [23]. Refractive error was converted into Spherical Equivalent (SE) by adding spherical component to half of the cylindrical component. SE for eye with better distance habitual VA or right eye (if both eyes had equal VA) was used for the analysis. SE was classified into emmetropia (-0.50D≤SE≤+0.50D), myopia (SE<-0.50D) and hyperopia (SE>+0.50D) [24]. In this study, age was categorised into age group of 60 to 69-year-old, 70 to 79-year-old and over 80-year-old. The BMI was categorised into underweight (BMI<18.5 kg/m^2), normal (18.5 kg/m^2≤BMI≤22.9 kg/m^2) and overweight (BMI≥23.0 kg/m^2) [25].

STATISTICAL ANALYSIS

The statistical analyses were performed using SPSS statistics version 23.0. The normality tests showed that all the parameters were normally distributed (p>0.05). Descriptive statistics were used to determine the prevalence of VI and status of refractive error. Pearson correlation was used to determine correlation between household income and VI whereas Kendall's Tau-b was used to determine correlation between age, educational level and smoking status with VI. Multivariate logistic regression was carried out on variable with p<0.20 in Pearson correlation and Kendall's Tau-b to determine the risk factors of VI (p<0.05) [26].

RESULTS

A total number of 230 subjects participated in this study. Only data of 201 subjects were analysed as 29 were excluded due to incomplete data. The subjects' socio-demographic, smoking status, health condition and BMI were summarised in [Table/Fig-1].

Characteristics	Value (n=201)
Races	
Malay	72 (35.8%)
Chinese	100 (49.8%)
Indian	29 (14.4%)
Gender	
Male	90 (44.8%)
Female	111 (55.2%)
Mean age	72.16±5.36 (Range: 64-89)
Educational level	
No formal education	23 (11.4%)
Primary	63 (31.3%)
Secondary	85 (42.3%)
Tertiary	30 (14.9%)
Mean monthly household income	RM2871.85±7451.12 (Range: RM200-RM100,000)
Smoking status	
Smoker	15 (7.5%)
Former smoker	20 (10.0%)
Non-smoker	166 (82.5%)
Hypertension	
Yes	109 (54.2%)
No	92 (45.8%)
Diabetes	
Yes	64 (31.8%)
No	137 (68.2%)
BMI	25.80±5.10 (Range: 14.84-58.60kg/m^2)
Underweight	8 (4.0%)
Normal	52 (25.9%)
Overweight	141 (70.1%)

[Table/Fig-1]: Socio-demographic characteristics, smoking status, health condition and BMI of subjects.

Habitual distance VA for better eye ranged from -0.10 logMAR to 0.94 logMAR with mean of 0.23±0.20 logMAR. Refractive error of better eye ranged from -9.00D to +3.63D with mean of +0.08±1.66D. Overall percentage of refractive error shows highest percentage of emmetropia (37.3%), followed by hyperopia (34.3%) and myopia (28.4%). The prevalence of VI was 27.3%, in which 33 subjects (16.4%) with mild VI, 22 subjects (10.9%) with moderate VI and no subjects with severe VI or blindness.

Pearson correlation shows significant correlation between monthly household income with VI (r=-0.11, p=0.11). [Table/Fig-2] shows Kendall Tau-b between races, gender, age, educational level, smoking status, health condition and BMI with VI. Kendall Tau-b showed significant correlation between age, educational level and smoking status with VI. There was no significant correlation between races, gender, hypertension and diabetes status and BMI with VI.

[Table/Fig-3] shows multivariate logistic regression between age, monthly household income, educational level and smoking status with VI. Multivariate logistic regression shows significant association between age >80 years with VI (OR=3.00, 95% CI=1.03-8.83). There was no significant association between monthly household income, educational level and smoking status with VI.

	1	2	3	4	5	6	7	8	9
1	-								
2	-0.06								
3	0.16*	-0.18*							
4	-0.21*	-0.21*	-0.14*						
5	0.07	0.28*	0.04	0.00					
6	0.02	-0.04	0.15*	-0.13*	-0.02				
7	0.10*	-0.14*	0.07	-0.08	-0.15*	0.31*			
8	-0.09*	0.07	-0.06	-0.07	-0.04	0.17*	-0.01		
9	0.04	0.01	0.14*	-0.23*	0.18*	-0.02	-0.01	0.02	-

[Table/Fig-2]: Kendall Tau-b between races, gender, age, educational level, smoking status, health condition and BMI with VI.
1=Races 2=Gender 3=Age 4=Educational level 5=Smoking status 6=Hypertension 7=Diabetes 8=BMI 9=VI; *Significance, p<0.20

Factors	Multivariate logistic regression	
	Odd ratio (95% confidence interval)	p-value
Age		
60-69	Reference	
70-79	1.08 (0.51-2.28)	0.85
80+	3.00 (1.03-8.83)	0.04*
Monthly household income	1.00 (1.00-1.00)	0.13
Educational level		
No formal education	Reference	
Primary	0.63 (0.23-1.73)	0.37
Secondary	0.38 (0.13-1.11)	0.08
Tertiary	0.36 (0.08-1.59)	0.18
Smoking status		
Smoker	Reference	
Former smoker	0.00 (0.00)	1.00
Non-smoker	2.16 (0.55-8.57)	0.27

[Table/Fig-3]: Multivariate logistic regression between age, monthly household income, educational level and smoking status with VI.
*Significance p<0.05

DISCUSSION

Selangor is a state with highest population of older adults in Central region of Malaysia. It was estimated that there were 502200 older adults in Selangor state in 2018 as compared to 133400 and 177000 in Negeri Sembilan and Kuala Lumpur, respectively [2]. Moreover, there was increment of 5.8% of elderly population in Selangor towards 474800 older adults in 2017. Previous study had shown that aging drastically increases risk for VI, thus necessitates a study on it among older adults [15,17]. Hence, this cross-sectional study can provide data on prevalence and risk factors of VI in addition to determining status of VA and refractive error among older adults in Selangor.

This study found a higher prevalence of VI as compared to 7.6% prevalence of VI found in NES II [14]. This was due to present study defined VI as habitual distance VA worse than 6/12 whereas NES II only considered moderate VI (6/18<VA≤6/60), severe VI (6/60<VA≤3/60) and blindness (VA<3/60) in the determination of prevalence of VI. It is more appropriate to consider mild VI in determining the prevalence of VI as a VA worse than 6/12 may affect daily activities and it is the minimum requirement for driving in Malaysia [27]. Prevalence of VI in this study is higher as compared to 21.8% VI in Sepang district [4]. This can be attributed to the difference in classification of VI as previous study defined VI as VA worse than 6/18. Moreover, study in Sepang involved younger subjects (mean age 52.9 years) as compared to present study. Nowak MS and Smigielski J, found higher percentage of age-related eye diseases (cataract, age-related macular degeneration, glaucoma, ocular hypertension and diabetic retinopathy) among subjects in an older age group (≥60 years) as compared to subjects in a younger age group (35-59 years) [28]. The study reported older age was significantly associated with those age-related eye diseases. There was no blindness in present study as compared to 2.9% blindness found in Sepang [4]. The difference in findings was due to improvement in ophthalmology services provided by Ministry of Health Malaysia over the years [29]. As reported in National Eye Database 2007, there were increased cases of treated eye diseases among Malaysian. Our findings showed higher prevalence of mild and moderate VI and lower prevalence of severe VI and blindness as compared to 7.4% mild VI, 7.2% moderate VI, 1.2% severe VI and 2.8% blindness among residents of West Java aged 50 years and above [13]. This could be due to lag in healthcare services provided in Indonesia such as longer waiting time, inconsistent and inaccurate findings and lack of treatment options being offered, consequently led to the delayed in treating of the ocular diseases prior to onset of blindness [30]. In addition, Malaysia offered better healthcare services and attracted medical tourists from Indonesia, India, China and Australia.

This study showed highest percentage of emmetropia, followed by hyperopia and myopia. The higher prevalence of hyperopia was due to the gradually increase in lens thickness with aging but lens paradox caused a decrease in gradient-index of the lens and lead to hyperopic shift [31]. However, nuclear sclerosis of the lens caused myopic shift which explained the myopia population among elderly [32]. Similar findings were found in study by Hashemi H et al., which reported 42.3% emmetropia, 34.1% hyperopia and 23.6% myopia among the rural population aged 40 and above in Iran [33]. Previous study in Asian countries reported higher prevalence of hyperopia among the elderly (41.5%-55.7%) as compared to this study [32,34,35]. The difference in findings could be due to the studies' were excluded because of their pseudophakic nature. Irving EL et al., found that the mean ocular refraction among elderly was significantly less hyperopic if those who undergone refractive surgery was not excluded [36]. The prevalence of myopia in our population is almost the same with elderly in Singapore (30.0%) and United Kingdom (27.8%) [35,37].

This study found that subjects over 80 years had increased risk for VI. Previous study in Asia also showed aging as a risk factor for VI [15,17,38,39]. This is due to increased risk of age-related ocular diseases such as cataract and macular degeneration with aging [40-42]. Study by Gan S et al., Tham YC et al., and Zimmerman EB et al., found low educational level was a risk factor for VI as high educational level had better awareness and understanding on information related to healthcare [38,39,43]. However, this study did not show an association between educational level and VI, it might be due to increasing geriatrics units and geriatricians practicing in healthcare services in Malaysia. Thus, every senior citizen is equally accessible to healthcare services regardless of their educational level [44].

This study showed gender was not significantly correlated with VI and this finding supported the studies by Nowak MS et al., Aljied R et al., and Thapa R et al., [11,28,45]. In contrast, Guo C et al., and Gan S et al., found that female had higher risk for VI due to less exposure to healthcare services [16,39]. Hence, it was not a surprise that present study did not find gender as a risk factor for VI as Malaysian population has equal exposure to healthcare services and treatments. This was proved by the National Eye Database 2017 report which showed that almost equal number of male and female patients who has undergone cataract treatment [46]. The present study found that races were not significantly correlated with VI. Similar results had been reported by Aljied R et al., and Wong TY et al., [11,47]. It could be attributed to the fact that there was no significant difference in utilization of healthcare services among Malaysian elderly of different races [48]. The present study did not found association between monthly household incomes with VI which contradicted with previous study [11,16]. The difference

in findings can be attributed to the current study using monthly household income as compared to previous study using yearly household income. Smoking status was not associated with VI in this study as reported by Gan S et al., [39]. This finding was contradicted by a study in Canada which found that smoker was at higher risk for VI [11]. This might be due to, the study classify subjects who smoked at least once in the past month as smoker. It is also possible that non-smokers were passive smoker causing the true effect of smoking on VI cannot be shown. Report showed that about 37% people exposed to second hand smoke either at home or workplace [49]. There was no significant correlation between health condition (hypertension and diabetic status) with VI. The present study findings supported the study by Chong EW et al., and Tham YC et al., [15,38]. As reported by Tham YC et al., and Gan S et al., there was no significant correlation between BMI and VI shown [38,39]. However, Pongsachareonnont P et al., reported normal BMI had higher risk for VI as compared to obesity because obesity led to systemic diseases which increased the possibility for ocular examination as a routine medical check-up at healthcare center [50]. Whilst other study was only focusing on rural residents, this study comprised of the whole of Selangor population. It is worth to point out that the healthcare services in rural areas in Malaysia had been improved [51]. The strength of this study was the prevalence of VI among elderly and was based on habitual VA which was more relevant and reflective of the usual vision status of the subjects for daily activities.

Limitation(s)

There were few limitations in this study. Determination of VI was solely based on VA and visual field was not considered which may potentially underestimate prevalence of VI. Systemic diseases were self-reported which may not be accurate if the subject did not go for the annual medical check-up. Causes of VI were also not determined in this study.

CONCLUSION(S)

The prevalence of VI among the elderly in Selangor was higher (27.3%) as compared with the previous study in Malaysia. The percentage of emmetropia was the highest, followed by hyperopia and myopia. The risk factor for VI among the elderly in Selangor is aging. There was no significant association between gender, race, educational level, monthly household income, smoking status, systemic diseases and BMI with VI. Further study on causes of VI could be carried out for targeted ocular health intervention in the future.

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