

Kertas Asli/Original Articles**Comparison of Driving Difficulty Between Bilateral Cataract and Non-Cataract Elderly Drivers in Malaysia: A Preliminary Study****(Perbandingan Kesukaran Memandu antara Pemandu Warga Emas dengan Bilateral Katarak dan Tanpa Katarak di Malaysia: Kajian Rintis)**

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ABSTRACT

An age-related ocular disease such as cataract that causes reduction of visual functions would affect the individual driving performance. The aim of this study was to compare driving difficulties between Malaysian drivers with bilateral cataracts and without cataract. This cross-sectional study involved measurement of visual functions [visual acuity (VA) and contrast sensitivity (CS)] and driving difficulty of 61 subjects who are actively driving with valid driving license. Subjects were divided into bilateral cataract group (n=30) and non-cataracts group as control group (n=31); which age and gender matched. Results showed that the mean±SD for composite driving difficulty score in the bilateral cataract group and in the control group were 72.08±15.95 and 87.50±12.60 respectively. It showed that both groups had lower mean composite score which indicates difficulty in driving. Results also showed significant mean difference composite driving difficulty score between cataract and control group (p<0.001). Drivers with bilateral cataracts were also found to have significant difficulty when driving the rain (p=0.034), at night (p=0.013) and when driving on local or highway (p=0.005) compared to drivers without cataract. Subsequent Spearman's Rho showed significant moderate positive correlation between driving difficulty and binocular CS ($r_s=0.404$, p=0.027). This study showed that drivers with cataract would experience driving difficulties compared to the drivers without cataract.

Keywords: Cataract; drivers; driving; driving difficulty; visual impairment

ABSTRAK

Penyakit okular yang berkaitan dengan usia seperti katarak boleh menyebabkan penurunan fungsi visual yang akan mempengaruhi prestasi memandu. Tujuan penyelidikan ini adalah untuk membandingkan kesukaran memandu antara pemandu Malaysia dengan bilateral katarak dan tanpa katarak. Kajian keratan rentas ini melibatkan pengukuran fungsi visual [tahap penglihatan (VA) dan sensitiviti kontras (CS)] dan kesukaran memandu dalam kalangan 61 subjek yang masih aktif memandu dengan lesen memandu yang sah. Subjek dibahagikan kepada kumpulan bilateral katarak (n=30) dan kumpulan kawalan (n=31). Keputusan menunjukkan purata dan sisihan piawai untuk skor komposit kesukaran memandu bagi kumpulan katarak dan kumpulan kawalan masing-masing adalah 72.08±15.95 dan 87.50±12.60. Ini menunjukkan kedua-dua kumpulan mempunyai purata skor komposit yang rendah iaitu mempunyai kesukaran memandu. Hasil kajian juga menunjukkan terdapat perbezaan yang signifikan skor komposit kesukaran memandu antara kumpulan katarak dan kumpulan kawalan (p<0.001). Pemandu yang mempunyai bilateral katarak juga mempunyai kesukaran yang signifikan ketika memandu dalam hujan (p=0.034) dan pada waktu malam (p=0.013) dan memandu di jalan raya dan lebuh raya (p=0.005) berbanding dengan pemandu tanpa katarak. Manakala analisis Spearman Rho menunjukkan korelasi positif yang signifikan kesukaran memandu dengan binokular CS ($r_s=0.404$, p=0.027). Kajian ini menunjukkan bahawa pemandu dengan katarak akan mengalami kesukaran memandu berbanding pemandu tanpa katarak.

Kata kunci: Gangguan visual; katarak; kesukaran memandu, memandu; pemandu

INTRODUCTION

Driving is a complex task involving an integration of visual, psychomotor and cognitive functions (Karthaus &

Falkenstein 2016). This functional integration is crucial for safe driving especially in elderly drivers (Keay et al. 2009). However, the changes associated with ageing cause deterioration of these three components even in healthy

people (Besdine 2013; Resnick 2015). These age-related functional changes will cause driving difficulty and reduce driving performance (Ghazilla & Yap 2016).

Owsley & McGwin (2008) stated that various age-related visual functions can lead to serious eye diseases that eventually cause visual impairment. In America, it is estimated that one out of six older adults have visual impairments (Dillon et al. 2010). Among the many causes of visual impairment brought about degenerative changes are Age Related Macular Degeneration (ARMD), glaucoma and cataract (Owsley & McGwin Jr 2008). In Malaysia, the main cause of visual impairment among older people age 50 years and above is senile cataract (Salowi & Goh 2016). Senile cataract is an eye disease characterised by progressive lens opacity due to aging (Hart 1992).

Deteriorating vision is one of the factors that increase the rate of accidents. (Owsley et al. 1999; Nischler et al. 2010). One of the most common causes for deteriorating vision with age is cataract. Owsley et al. (Owsley et al. 1999) stated that the older drivers with cataract will experience driving difficulties, reduced driving performance and an increased risk of accidents. It also showed that, older drivers with cataract have also have significant difficulties driving in some situations (e.g. in the rain, rush hour, busy traffic road, making a left turn and driving on local road or interstates). In addition, Nischler et al. (2010) study found that the driving performance of drivers with advanced cataract significantly will be reduced. It was reported that cataract drivers with driving difficulty are twice as likely to get accident compare to elderly drivers without cataract (Owsley et al. 1999). It showed that older drivers with cataract have significant restriction in their driving performance and a decrease in their safety on the road. Ghazilla & Yap (2006) also mentioned that reduction in VA and CS among cataract drivers could affect driving performance such as reading signage, viewing objects under low contrast condition, and viewing vehicle in adjacent lanes.

However, these studies were done in western countries with different weather and traffic environment compared to Malaysia. Furthermore, to our knowledge there is no study on driving difficulty among bilateral cataract drivers in Malaysia. Therefore, this study aimed to address the gap by comparing driving difficulty status among Malaysian drivers with bilateral cataract and drivers without cataract.

MATERIALS AND METHODS

The purposes, protocols, benefits and risks of the study were explained to the subjects before they provide written informed consent. The study was conducted in accordance with the Declaration of Helsinki. All and the study protocol

was approved by Universiti Kebangsaan Malaysia Ethics Committee (UKM PPI/111/18/JEP-2017-684) and by Malaysia Medical Research & Ethics Committee (KKM/NIHSEC/P17-1583(5)).

A total of 61 subjects who attended Ophthalmology Clinic, Hospital Malacca from October to November 2017. Out of 61 subjects, 30 were diagnosed with bilateral cataract and were placed in the cataract group, whereas the remaining 31 subjects were normal (without cataract) and were placed in the control group. Both groups were age and gender matched. The inclusion criteria were 1) 50-year-old and above; 2) physically good and fit to drive; 3) holding valid driving license 4) driving at least once a week. Sample size was calculated using Cochran's formula with $\alpha=0.05$, $\delta=0.10$ and proportion of 0.037 (Cochran 1963). The proportion is based on the prevalence of cataract among the 50 years old and above in Malaysia which is 3.7% (Salowi & Goh 2016).

Written consent was obtained from all the subjects after they were briefed with detailed explanations about the study's objectives and requirements. Demographic data on gender, age, driving characteristics and type of vehicle transmission were confirmed from the interviews. General health was evaluated according to the Medical Examination Standards for Vocational Driver's Licensing guideline by the Ministry of Health Malaysia (Occupation Health Unit Ministry of Health Malaysia 2011). Ocular health assessment was assessed by an ophthalmologist. The subjects were classified to cataract group when they have been diagnosed with bilateral cataract whereas subjects without cataract were recruited as control based on The Lens Opacities Classification System III (Chylack et al. 1993).

Subsequently, visual functions of best-corrected visual acuity (BCVA) and contrast sensitivity (CS) have been performed on those who passed the general health assessment. BCVA and CS were measured using Early Treatment Diabetic Retinopathy Study (EDTRS) logMAR chart at 4 meters and Pelli Robson chart at 1 meter, respectively. Binocular BCVA and CS were recorded in logMAR unit and log contrast sensitivity unit, respectively.

A face to face interview session was conducted using Malays version Driving Difficulty Questionnaire (Owsley et al. 1999). Subjects in this study were ensured to have the required level of Malay language proficiency and that he/she fully understood each question being asked. The driving difficulty questionnaire consists of eight questions which were related to different driving situations: driving in raining, driving alone, parallel parking, making right turn, driving on local road or highway, driving in high traffic, driving in rush hour and driving at night. Subjects were asked to rate the degree of visual difficulty experienced in specific driving situations based on a 6-point Likert

scale (5 = no difficulty, 4 = a little difficulty, 3 = moderate difficulty, 2 = extreme difficulty, 1 = no longer drive in that situation due to visual problems, 0 = no longer drive in that situation because of other reason than visual problems). A composite score of driving difficulty was computed based on a 100-point scale [(mean score - 1) X 25] (Owsley et al. 1999). Subjects with a score of less than 90 were identified as having driving difficulty.

The statistical analyses were performed using SPSS statistics version 23.0. Demographic data were described using descriptive statistics that were expressed as mean and standard deviation (mean±SD) and in percentage (%). Independent T-Test was used to compare the mean score of driving difficulty between cataract and control groups. Chi-square test was performed to determine the association between each driving situation and subjects group.

RESULTS

DEMOGRAPHIC DATA

The mean age of subjects for the cataract and control groups were 63.23±5.39 years old, ranged between 53 and 75 years old and 60.87±6.64 years old, ranged between 50 and 74, respectively. There was no statistically significant difference in mean age between cataract and control groups, $t(59) = 1.53, p = 0.14$. Both groups were gender-matched. The details of the respondent demographic, visual functions and driving profiles as in Table 1.

DRIVING DIFFICULTY STATUS

The mean composite driving difficulty score in cataract and control groups were 72.08±15.95 and 87.50±12.60, respectively. A significant lower composite score was revealed in cataract group compare to control group ($t(59) = -4.195, p < 0.001$). Moderate negative correlation was revealed between driving difficulty and binocular VA ($r_s = -0.268, p = 0.146$). However, the correlation was statically not significant. Whereas for CS, Spearman's Rho showed significant moderate positive correlation between driving difficulty and binocular CS ($r_s = 0.404, p = 0.027$).

DRIVING DIFFICULTY IN CATARACT GROUP AND CONTROL GROUP IN DIFFERENT TYPE OF DRIVING SITUATIONS

Table 2 shows the comparison of driving difficulty status for different driving situations. Majority of the cataractous subjects reported difficulty driving in the rain (90%), driving at night (87%) and driving in traffic congestion (57%). Out

of the eight driving situations, only two situations were found to be statistically significantly different between both groups. The driving difficulty status for the cataract group were found to be statically significant compared to the control group when driving in the rain [$\chi^2 = (1, n=30) = 4.504, p = 0.034$], when driving on local or highway [$\chi^2 = (1, n=30) = 7.974, p = 0.005$], and when driving at night [$\chi^2 = (1, n=30) = 6.205, p = 0.013$] compared to the non-cataract subjects. In addition, three subjects from the cataract group reported that they stop driving if it rains and seven subjects reported that they stop driving when night approaches. None of the subjects from the control group reported that they stop driving in any of the eight situations.

DISCUSSION

The current study reveals that that the mean VA (6/18) of subjects in cataract group does not meet the minimum VA requirement set by the Malaysia Road Transport Department which is 6/12 (Occupation Health Unit Ministry of Health Malaysia 2011). This is due to that the annual medical examination only made compulsory for the Public Service Vehicle licence (PSV) and Vocational Driving Licence (VDL) or Commercial Driving Licence. Therefore, this situation enables them to legally keep their driving license even though their VA does not fulfil the minimum standard vision requirement. This is different from other countries such as in the European Union (EU) where elderly drivers must undergo medical examination to renew their driving license (Helman et al. 2017). This special licensing procedure varies among countries. For instance, in United Kingdom (UK) and Netherlands, Certificate of Medical Fitness to Drive (MFTD) is required when the driver reaches 70 years old. In France, Iceland, Norway and Latvia, the first MFTD re-test is required when the driver reaches 60 years old. In contrast, Portugal requires the MFTD re-test when the driver reaches 40 years old, which is the youngest age, compared to the other countries requiring the MFTD re-test (Helman et al. 2017).

The current study reveals that drivers with cataract experienced significant difficulty driving especially in the rain and at night, compared to drivers without cataract. Some of the subjects decided not to drive in both situations due to their vision status. This finding is consistent with Nischler et al. (2010) where they have found that cataract drivers had difficulties driving during bad weather or at night. Driving in the rain and at night are examples of low contrasts situations that are challenging for older drivers with cataract as they have difficulties detecting objects in those environments (Fraser et al. 2013). Mäntyjärvi & Tuppurainen (1999) supported this finding and mentioned that drivers with reduced CS function reported difficulty

TABLE 1. Demographic characteristic, visual acuity, contrast sensitivity and driving profile

Characteristic	Cataract n=30 (%)	Control n=31 (%)
Age (mean± SD)	63.23±5.39	60.87±6.64
Gender		
Male	21 (70.0)	22 (71.0)
Female	9 (30.0)	9 (29.0)
Race		
Malay	18 (60.0)	21 (67.7)
Chinese	9 (30.0)	8 (25.8)
Indian	3 (10.0)	2 (6.5)
Driving per week		
Once	1 (3.3)	2 (6.5)
Twice	1 (3.3)	3 (9.7)
3 times	2 (6.7)	4 (12.9)
More than 4 times	26 (86.7)	22 (71.0)
Duration of owning driving licence		
1 - 9 years	1 (3.3)	0 (0)
10 - 19 years	1 (3.3)	2 (6.5)
20 - 29 years	3 (10.0)	7 (22.6)
More than 30 years	25 (83.3)	22 (71.0)
Vehicle transmission		
Manual	11 (36.7)	11 (35.5)
Automatic	13 (43.3)	7 (22.6)
Manual and Automatic	6 (20.0)	13 (41.9)
Visual acuity (mean± SD)		
Right eye	0.60±0.20	0.13±0.10
Left eye	0.61±0.25	0.14±0.09
Binocular	0.53±0.19	0.10±0.08
Contrast sensitivity (mean± SD)		
Right eye	1.14±0.27	1.55±0.16
Left eye	1.06±0.35	1.56±0.18
Binocular	1.25±0.30	1.67±0.13

when driving especially at dawn, dusk and night. The current study also reveals that reduced CS will increase driving difficulty among cataract drivers. In drivers with cataract, these challenging driving situations were reported to be the most commonly avoided (Ghazilla & Yap 2016).

Our findings were also parallel with previous study which found that higher percentage of subjects had difficulty driving in the rain (67%) and at night (77%) (Owsley et al. 1999). However, compared to the current study (Table 1), these results were lower due to differences in the level of VA and CS. The current study has a better VA and CS compare to the study by Owsley et al. (1999). This finding was also supported by Nischler et al. (2010) where they found an increase in cataract intensity will significantly reduce driving performance. Previous study also mentioned that reduction in VA and CS among cataract

drivers could affect driving related tasks such as reading signage, viewing objects under low contrast condition, and viewing vehicle in adjacent lanes (Ghazilla & Yap 2016).

Apart from the difficulties when driving in the rain and at night, Owsley et al. (1999) reported that, older drivers with cataract have also encountered significant difficulties driving in other situations (e.g. in rush hour, busy traffic road, making a left turn and driving on local road or interstates). Although our subjects with cataract had lower levels of VA and CS compared to the subjects in Owsley et al. (1999) study, our subjects showed no greater difficulties in other situations except driving on local road or highway. The current study also stated that, majority of our subjects used automatic transmission vehicle compared to manual transmission vehicle, which might reduce difficulty driving in other situations. Previous

TABLE 2. Driving difficulty status for different driving situations in cataract and control group

Items	Cataract N=30 (%)	Control N=31 (%)	P value (Chi-Square)
Driving in rain			
Difficult (Score 1-4)	27 (90)	21 (68)	0.034
No difficulty (Score 5)	3 (10)	10 (32)	
Driving alone			
Difficult (Score 1-4)	10 (33)	8 (25)	0.519
No difficulty (Score 5)	20 (67)	23 (75)	
Parallel parking			
Difficult (Score 1-4)	10 (33)	8 (26)	0.519
No difficulty (Score 5)	20 (67)	23 (74)	
Making right turn			
Difficult (Score 1-4)	3 (10)	1 (3)	0.285
No difficulty (Score 5)	27 (90)	30 (97)	
Driving on local road or highway			
Difficult (Score 1-4)	6 (20)	1 (3)	0.005
No difficulty (Score 5)	21 (70)	30 (97)	
Driving in traffic congestion			
Difficult (Score 1-4)	17 (57)	12 (39)	0.160
No difficulty (Score 5)	13 (43)	19 (61)	
Driving during rush hour			
Difficult (Score 1-4)	14 (47)	10 (32)	0.373
No difficulty (Score 5)	16 (53)	21 (68)	
Driving at night			
Difficult (Score 1-4)	26 (87)	18 (58)	0.013
No difficulty (Score 5)	4 (13)	13 (42)	

study have shown that older adults who use vehicles with automatic transmission displayed an improve driving performance compare to those who use vehicles with manual transmission (Selander, Bolin & Falkmer 2012). Selander et al. (2012) further mentioned that older drivers using automatic transmission cars made significantly fewer error compared when they were driving using manual transmission cars in five driving situations 1) manoeuvring-changing gear; 2) manoeuvring-handling pedals; 3) speed-too fast for the situations; 4) traffic rules- exceeding speed limits, and 5) position-turn left. However, we were unable to compare this current study with previous study since the information on the type of vehicle used by the subjects were not mentioned in this current study.

One drawback of our study was response through questionnaire which may differ in different setting such as on-road driving evaluation. It seems that this study lack of measurement on driving performance such as presence of glare from the sun, glare from incoming headlights at night, complex intersection, and level of alertness during driving. But some way, this study was actually indirectly measured the details in the Driving Habits Questionnaire

(DHQ) (Owsley et al. 1999) for instance glare from incoming headlights at night were indirectly asked in question no.8, level of alertness was indirectly measured in question no 6 and question no 7. Therefore, the level of driving difficulty in that specific situations were indirectly measured. This study analysed and compared driving difficulty status among drivers with bilateral cataract and without cataract. Since cataract is an irreversible visual impairment (Flaxman et al. 2017), it is crucial to determine whether older drivers who have had cataract removal surgery would display an improvement in their driving performance. In addition, it is also important to assess the length of time required (post cataract surgery), before they are able to drive again.

CONCLUSION

In Malaysia, older drivers with bilateral cataract were found to experience driving difficulty compared to drivers without bilateral cataract, especially in low contrast situation. In addition, this study also showed the importance of other

visual function assessments such as VA when renewing driving licences among older drivers.

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REFERENCES

- Besdine, R. 2013. *Changes in the Body with Aging. The Merck Manual*. Whitehouse Station, NJ: Merck Sharp & Dohme Corp.
- Chylack, L.T.Jr., Wolfe, J.K., Singer, D.M., Leske, M.C., Bullimore, M.A., Bailey, I.L., Friend, J., McCarthy, D. & Wu, S.Y. 1993. The Lens Opacities Classification System III. The Longitudinal Study of Cataract Study Group. *Archives of Ophthalmology* 111(6): 831-836.
- Cochran, W.G. 1963. *Sampling Techniques. 2nd Edition*: John Wiley & Sons.
- Dillon, C.F., Gu, Q., Hoffman, H.J. & Ko, C.-W. 2010. Vision, hearing, balance, and Sensory impairment in Americans aged 70 years and over: United States, 1999-2006. *NCHS data brief* 31(31): 1-8.
- Flaxman, S.R., Bourne, R.R.A., Resnikoff, S., Ackland, P., Braithwaite, T., Cicinelli, M.V., Das, A., Jonas, J.B., Keeffe, J., Kempen, J.H., Leasher, J., Limburg, H., Naidoo, K., Pesudovs, K., Silvester, A., Stevens, G.A., Tahhan, N., Wong, T.Y., Taylor, H.R. , on behalf of the Vision Loss Expert Group of the Global Burden of Disease Study. 2017. Global causes of blindness and distance vision impairment 1990-2020: a systematic review and meta-analysis. *The Lancet. Global Health* 5(12): e1221-e1234.
- Fraser, M.L., Meuleners, L.B., Ng, J.Q. & Morlet, N. 2013. Driver self-regulation and depressive symptoms in cataract patients awaiting surgery: a cross-sectional study. *BMC ophthalmology* 13(1): 45.
- Ghazilla, R.A.R. & Yap, H.J. 2016. Review of elderly driver visual perception simulation system for vehicle design. *Malaysian Journal of Public Health Medicine* 16(2): 113-120.
- Hart, W. 1992. *Adler'S Physiology of the Eye : Clinical Application*. St. Lous: Mosby.
- Helman, S.V., Fildes, W., Oxley, B., Fernández-Medina, J. & Weekley, J. 2017. Study on driver training, testing and medical fitness: final report. *European Commission. Directorate-General for Mobility and Transport*.
- Karthaus, M. & Falkenstein, M. 2016. Functional changes and driving performance in older drivers: assessment and interventions. *Geriatrics* 1(2): 12.
- Keay, L., Munoz, B., Turano, K.A., Hassan, S.E., Munro, C.A., Duncan, D.D., Baldwin, K., Jasti, S., Gower, E.W. & West, S.K. 2009. Visual and cognitive deficits predict stopping or restricting driving: the Salisbury Eye Evaluation Driving Study (Seeds). *Investigative ophthalmology & visual science* 50(1): 107-113.
- Mäntyjärvi, M. & Tuppurainen, K. 1999. Cataract in traffic. *Graefe's archive for clinical and experimental ophthalmology* 237(4): 278-282.
- Nischler, C., Michael, R., Wintersteller, C., Marvan, P., Emesz, M., Van Rijn, L.J., Van den Berg, T., Wilhelm, H., Coeckelbergh, T. & Barraquer, R.I. 2010. Cataract and pseudophakia in elderly European drivers. *European Journal of Ophthalmology* 20(5): 892-901.
- Occupation Health Unit Ministry of Health Malaysia. (2011). *Medical Examination Standards for Vocational Drivers Licensing*. <http://www.jpj.gov.my/en/pembaharuan-lesen-vokasional> [26 February 2018].
- Owsley, C. & McGwin Jr, G. 2008. Driving and age-related macular degeneration. *Journal of Visual Impairment & Blindness* 102(10): 621-635.
- Owsley, C., Stalvey, B., Wells, J. & Sloane, M.E. 1999. Older drivers and cataract: driving habits and crash risk. *The Journals of Gerontology Series A, Biomedical Sciences and Medical Sciences* 54(4): M203-M211.
- Resnick, B. 2015. Resilience: the key to successful aging. *The Gerontologist* 55(Suppl. 2): 366-367.
- Salowi, M.A. & Goh, P.P. 2016. *Eighth Report of the National Eye Database 2016*. Kuala Lumpur.
- Selander, H., Bolin, I. & Falkmer, T. 2012. Does automatic transmission improve driving behavior in older drivers? *Gerontology* 58(2): 181-187.
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