Clinical and Experimental Vision and Eye Research (2021), 4, 25–29

ORIGINAL ARTICLE

Habitual driving vision in a large urban cohort in Western India – factors associated with non-adherence to Indian guidelines

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Keywords:

Visual acuity, Habitual visual acuity, Motor vehicle act

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Received: 24-06-2021;
Accepted: 07-07-2021
doi: 10.15713/ins.clever.63

Abstract

Background: Habitual visual acuity (HVA) and driving eligibility as per current regulations has not been assessed in a large population setting. The previous studies conducted on HVA are from a hospital setting where best corrected visual acuity (BCVA) recorded at the hospital is used to ascertain if the driving standards are met. HVA is best checked in the "real world" and would give a more accurate assessment of the proportion of drivers maintaining vision standards mandated by motor vehicle act while they are driving. While a BCVA may suffice for licensing purposes to satisfy the regulatory requirements, the safety of the driver and his surroundings is dependent on his HVA which is the visual acuity when they are driving.

Aim: In this population based study of visual acuity in an urban population in western India, we aim to study the habitual driving visual acuity and factors associated with non-adherence to driving guidelines.

Results: Of the 3268 participants driving a personal passenger vehicle, 9 (2.8%) had HVA less than 6/12 in both eyes. 3176 (97.2%) had HVA of at least 6/12 in one eye making them compliant with the Motor vehicle act regulations.

Conclusion: Self-reported visual handicap is often not commensurate with the actual visual acuity, and disability.

Introduction

Driving vision: Perception and actual

Across the globe, there are three tests that determine eligibility for a driving license. These include visual acuity, on-road performance, and knowledge tests. Given that as many as eight out of ten accidents and fatalities may be directly attributed to driver error, visual functions are an important correlate for driver safety evaluation.[1]

There is significant evidence to prove that visual acuity alone is not a good predictor of driving safety and that other parameters such as visual fields (especially useful field of view), color vision, night vision, contrast sensitivity, and glare sensitivity are important considerations.

In India a driving license is issued by the Regional Transport Office regulated by the motor vehicle act (MVA) 1988, amended in 2017. As per the MVA, to obtain a driving license for a non-transport vehicle the applicant needs to complete a self-declaration form with a medical certificate from a registered medical practitioner. In this population based study of visual acuity in an urban population in western India, we aim to correlate the recorded visual acuity with the perceived visual acuity, with an attempt to focus on useful driving vision.

Materials and Methods

A large cohort in Western India underwent habitual visual acuity (HVA) assessment, diabetes screening by random finger prick blood sugar, blood pressure screening, and screening for blinding retinal conditions such as diabetic retinopathy, retinal vascular diseases, age-related macular degeneration, and any optic disc abnormalities using a non-mydriatic fundus photograph.

The cohort for this study is from a screening project conducted in 2018 over a 10 day period. The screening is conducted in the community at a prominent location in the metropolitan city of

Mumbai. 50,000–60,000 people a day and people of various age groups educational and socio-economic backgrounds visit this location making it an ideal location to assess a heterogeneous cohort which would be representative of a population of a large urban city in Western India.

HVA assessment

Trained optometrists of our center measured visual acuity using Snellen charts at 6 m. English letter charts, Hindi letter charts (using devnagri script). and "E" charts were used. All the optometrists underwent intensive training for 1 week before this study to ensure standardization of visual acuity measurement.

All the participants were asked to wear their glasses, if they had glasses, HVA of each eye of the participant was measured. Participants who had only reading glasses were assessed unaided. Participants who gave history of wearing glasses but did not carried the glasses with them were assessed unaided.

HVA of each eye was recorded using the standard nomenclature (6/6, 6/9, and so on). Participants with HVA less than 6/60 were assessed for counting fingers at 1 m, hand movements close to face, perception of light, and no perception of light. Pin-hole visual acuity and near vision assessment was not done.

Survey

A voluntary questionnaire survey was administered to every 5th participant who registered for the free diabetic retinopathy screening survey during a Ganpati festival in Mumbai. If this 5th participant refused participation, then the next participant was asked to participate. Trained professional survey personnel administered the questionnaire survey (Leadtech Private Limited, New Delhi). The surveys were designed to assess the knowledge, attitude, and awareness of the participants regarding diabetes and diabetes related eye disease.

Validated questionnaire surveys were modified using community based focus discussions. The survey was designed in English and translated to Hindi and Marathi, the two most common languages used in Mumbai.

Translation based discrepancies were checked by administering both the English and translated questionnaires to un-involved and un-biased local doctors (general practitioners, diabetologists, and ophthalmologists) (n = 50). Based on their observations, using the English questionnaire as the standard, the language of the translated questionnaires was modified.

The final modified questionnaire was then piloted among 100 random patients and relatives in the out-patient department of authors NK, SB, and MW. Based on the responses from the participants and the observations of the survey personnel, the survey was further modified to ensure clarity of questions to the lay person irrespective of their educational status, clear understanding of the options for the questions and to ensure that the survey took no more than 7 min to complete.

The modified questionnaire was finalized by prior piloting it among 100 random volunteers at the hospital (none of them medical or para-medical professionals). Professional survey personals using electronic devices such as ipads and tablets administered the questionnaire survey. Leadtech software used for the current study has their proprietary. All the questions had forced choice responses, multiple options (for some questions only 1 response was allowed and for some multiple responses could be selected) and there was no free text for responses of the questionnaire. No blank responses were permitted.

For this study, we analyzed HVA in each eye and use the demographic data from the survey. Other parts of the questionnaire are being analyzed and published as separate reports.

To meet the MVA standards, which are subjective, it was decided that to match the MVA guidelines the driver must have 6/12 vision or better in at least 1 eye. As MVA regulations for car and motorized two wheelers are the same, the car and two-wheeler cohort has been considered a single cohort (personal passenger vehicle). As there are no specific visual function guidelines for heavy goods vehicle DL, we used the UK standard as a benchmark, which requires 6/7.5 vision in the better eye and at least 6/60 in the other eye. As 6/7.5 is not part of the standard Snellen chart we have used a criteria of 6/6 in at least one eye for the statistics of this group.

Statistical analysis

Statistical Package for the Social Sciences II software (version 13.0, SSPS Inc., Chicago, III, USA) was used to analyze the data so collected. Data were presented in frequency (%) and mean with standard deviation.

For assessing the association of categorical variable with demographic variables, the Chi-square test/Fischer exact test was used. For assessing normality, the Kolmogorov–Smirnov test was applied. To compare of dichotomous variables which were represented as percentages, we used the Chi-square test. The Pearson test and two tailed Spearman's rank correlation were used to determine correlation between values. $P < 0.05$ was taken to be statistically significant.

Results

During the 10 day screening project in 2018, 31,982 participants underwent the screening tests described above. 6396 of the 31,982 participated in the questionnaire survey and formed the cohort for this study. 96 of the 6396 participants (1.5%) were excluded from further analysis due to incomplete data or duplication on the survey.

Of the 6300 eligible participants, 1660 were female (26.3%) with 327 (5.2%) above 60 years, 2187 (34.7%) between 41 and 60 years and 3786 (60.1%) between 18 and 40 years [Table 1].

Of the 3268 participants driving a personal passenger vehicle, 9 (2.8%) had HVA less than 6/12 in both eyes. 3176 (97.2%) had HVA of at least 6/12 in one eye making them compliant with the MVA regulations. 6 of the 34 (17.6%) heavy goods vehicle

Table 1: Demographic characteristic of study participant

Demographic parameters of participants	*n* (%)
Age (years)	
18–40	3786 (60.1)
41–60	2187 (34.7)
>60	327 (5.2)
Gender	
Male	4640 (73.7)
Female	1660 (26.3)
Education	
Less than 10th standard	3294 (52.3)
Graduate	2434 (38.6)
Post graduates	572 (9.1)
Annual income	
<50,000	2766 (43.9)
50,000–2 lakhs	2518 (40)
>2 lakhs	1016 (16.1)

Table 2: Factors associated with HVA not complying with the MVA regulations (HVA less than 6/12 in both eyes) for two wheeler vehicles

Parameter	HVA at least 6/12 in one eye (%)	HVA less than 6/12 in both eyes (%)	*P*-value
Age (years)			
18–40	1507 (98.2)	27 (1.8)	<0.001
40–60	493 (95.4)	24 (4.6)	
>60	42 (87.5)	6 (12.5)	
Sex			
Male	1794 (97.2)	52 (2.8)	0.44
Female	248 (98)	5 (2)	
Education			
<10th standard	890 (96.4)	33 (3.6)	0.08
Graduate	945 (97.8)	21 (2.2)	
Postgraduate	207 (98.6)	3 (1.4)	
Residence			
Urban	1958 (97.3)	55 (2.7)	0.82
Other	84 (97.7)	2 (2.3)	
Annual income (INR)			
<50,000	737 (96.6)	26 (3.4)	0.29
50,000–2 lakhs	944 (97.8)	21 (2.2)	
>2 lakhs	361 (97.3)	10 (2.7)	

drivers had HVA of at least 6/6 in both eyes. 83.4% had HVA in at least 1 eye [Tables 2-4].

Table 3: Factors associated with HVA not complying with the MVA regulations (HVA less than 6/12 in both eyes) for two wheeler DL

Parameter	HVA at least 6/12 in one eye (%)	HVA less than 6/12 in both eyes (%)	*P*-value
Age (years)			
18–40	2224 (98.2)	40 (1.8)	<0.001
40–60	880 (95.3)	43 (4.7)	
>60	72 (88.9)	9 (11.1)	
Sex			
Male	2864 (97.2)	84 (2.8)	0.72
Female	312 (97.5)	8 (2.5)	
Education			
<10th standard	1280 (96.2)	50 (3.8)	0.026
Graduate	1485 (97.8)	33 (2.2)	
Postgraduate	411 (97.9)	9 (2.1)	
Residence			
Urban	3057 (97.1)	90 (2.9)	0.43
Other	119 (98.3)	2 (1.7)	
Annual income (INR)			
<50,000	1052 (96.2)	42 (3.8)	0.043
50,000–2 lakhs	1480 (97.7)	35 (2.3)	
>2 lakhs	644 (97.7)	15 (2.3)	

Discussion

Self-declaration carries three questions related to visual function – (1) Is the applicant able to distinguish a car number plate from 25 m, (2) Is the applicant able to distinguish pigmentary colors red and green, and (3) Does the applicant have night blindness? All of these questions are answered by the applicant as a self-assessment, and then validated by a Registered Medical Practitioner via an examination.

It is estimated that in India uncorrected refractive errors are responsible for 68% of moderate to severe visual impairment and 37% of blindness. Even among those who are wearing glasses 20% had vision of less than 6/12 in the better eye.[1,3,4]

While a BCVA may suffice for licensing purposes to satisfy the regulatory requirements, the safety of the driver and his surroundings is dependent on his HVA which is the visual acuity when they are driving. In a previous study in a large urban population in western India reported that HVA was less than 6/6 in both eyes in more than 34% of the cohort and less than 6/12 in both eyes in about 10% of the cohort. About 5% had HVA of less than 6/18 in both eyes.[5,7]

In a large study from Northern India, it was noted that 20% of those studied wearing glasses had HVA worse than 6/12 in the better eye which improved to at least 6/12 in both eyes with an updated glass prescription, implying that their HVA despite

Table 4: Factors associated with HVA less than 6/6 in both eyes for heavy goods vehicle DL

Parameter	HVA at least 6/6 in one eye (%)	HVA less than 6/6 in both eyes (%)	*P*-value
Age (years)			
18–40	15 (88.2)	2 (11.8)	0.386
40–60	12 (80)	3 (20)	
>60	1 (50)	1 (50)	
Sex			
Male	28 (82.4)	6 (17.6)	NA
Female	0	0	
Education			
<10th standard	20 (76.9)	6 (24.1)	0.326
Graduate	7 (100)	0 (0)	
Postgraduate	1 (100)	0 (0)	
Residence			
Urban	26 (81.3)	6 (19.7)	0.50
Other	2 (100)	0 (0)	
Annual income (INR)			
<50,000	4 (80)	1 (20)	0.385
50,000–2 lakhs	17 (77.3)	5 (22.7)	
>2 lakhs	7 (100)	0 (0)	

wearing glasses would not meet the MVA standards if they were driving.[5] This implies that there is a large proportion of the population with vision less than the MVA standards even amongst those wearing glasses [Tables 1 and 2]. A population-based study from Tirunelveli district of South India has reported presenting and best corrected VA ≥ 6/18 in 59.4% and 75.7%, respectively.[7] In our study (97.2%) had HVA of at least 6/12 in one eye making them compliant with the MVA regulations. Another study from rural Rajasthan in older adults (>50 years) reported presenting VA better than 6/18 in 47.6% cases which is also lower than the present study, which included younger patients as well.[8] The main cause of visual impairment in this study in population with visual acuity between 6/12 and 6/6 was refractive error which is easily treatable. Both studies identified low education and income to be significantly associated with poor VA.

These results concur with the previous studies that have noted that older drivers are more likely to have poorer vision and as a group they have a higher non-compliance rate with VA standards for driving [Tables 3 and 4]. This is probably due to the development of cataract and other aging eye disorders such as age-related macular degeneration.[4,5] The older population may also find it more difficult to gain access to eye care, including optician review due to difficulties in transport, mobility issues, other health issues, and economic constraints due to limited income or dependency on others for their healthcare needs. The proportion of Indians above 60 years is currently about 8% of the total population. Hence, India is predominantly a young country and a majority of drivers are younger drivers who we have demonstrated are highly likely to have HVA that meets the MVA standards. For the group above 60 years more strict, MVA standards may be needed or the enforcement of MVA standards needs to be more stringent. An ideal opportunity to ensure compliance with MVA standards is during DL renewal. This is an opportunity to ensure VA meets the standards during DL license renewal at least.

In India, there is no doubt that there is a significant underreporting of vision related disability when applying for a driving license, or for its renewal. Moreover, even the drivers who hold an active driving license also are known to have significant vision related problems that may put them at risk for of road traffic accidents.[8-10] This may be because of two reasons: One, applicants do not perceive an actual visual disability[1,3] and two, they may want to not report the visual handicap so as to retain the advantages of having a driving license. In either case, they put themselves, as well as other commuters at risk. In our study, we have attempted to concentrate on the former, the fact that the actual vision, and the perceived vision may not always be the same, and that the perception of decreased vision is often not accurate.

Limitations

At the outset, it is also important to mention that visual acuity alone is not an indicator for the visual correlates that influence driver safety. However, since most licensing authorities, including those in India, use it as a criterion for evaluating eligibility for driving licenses, it is an important attribute.

The other correlates of vision that is important for perceptual and cognitive responses include visual fields, color vision (especially protanopia), night vision, contrast sensitivity, glare sensitivity, depth perception, and any double vision/shadowing.[2,6,8] It is, therefore, imperative that a complete examination of ocular function be considered when evaluating vision for driver safety.

In our study, we have only studied the best corrected central visual acuity and correlated the self-reported visual handicap with various demographic factors.

Conclusion

Self-reported visual handicap is often not commensurate with the actual visual acuity, and disability. This may be one of the factors for the underreporting of visual disability when filling up forms for driving licenses.

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How to cite this article: Bhartiya S, Kumar N, Dhigra D, Wadhwani M. Habitual driving vision in a large urban cohort in Western India - factors associated with non-adherence to Indian guidelines. Cli Exp Vis Eye Res J 2021;4(1):25-29.