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Refractive errors among commercial drivers

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Purpose: To determine the pattern of refractive error among commercial drivers in north India. **Methods:** Descriptive study with convenient sampling conducted among commercial drivers of north India. **Results:** A total of 213 (75.8%) heavy-vehicle and 68 (24.2%) light-vehicle drivers were screened for eye diseases. Refractive error for distance was reported in 44 (15.7%; 95% CI: 11.6–20.4) drivers. Hyperopia was reported in 23 (8.2%; 95% CI: 5.2–12) drivers, followed by myopia in 15 (5.3%; 95% CI: 3–8.6) drivers and astigmatism in six (2.1%; 95% CI: 0.7–4.5) drivers. Presbyopia was reported in 157 (55.8%) drivers. Dry eye was reported in 70 (24.9%), stereo deficiency in 77 (27.4%), and color vision deficiency in 11 (3.9%) drivers. Three drivers were diagnosed with cataract, and two were referred for retina evaluation. **Conclusion:** Hyperopia in both eyes was the most common refractive error. Dry eye disease and color vision deficiency were also reported. Most of the drivers were not using spectacles for refractive error correction. Due to their mobile nature, drivers with cataract and retina diseases did not turn up for follow-up.

Key words: Color vision, commercial drivers, dry eye, eye diseases, north India, presbyopia, refractive error

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India's transport sector caters to the needs of 1.1 billion people and generates maximum employment after agriculture.[1,2] It is considered as the lifeline of commercial and economic development.[1-3] Commercial drivers play a major role in our transport. Due to their challenging life style, heavily regulated work and rest times, irregular sleep patterns, limited opportunity for exercise, and limited access to nutritious food on the road, the health status of commercial drivers is compromised. Morbidity profile of Indian commercial drivers has been reported in many studies.[4,5] It has been reported that transport workers are at increased risk of work-related injuries.[6] Uncorrected refractive error is a public health concern and may lead to loss of employment opportunities and lower productivity.[7,8] Refractive status of a person changes with the age of a person. One needs different kinds of vision to be able to drive safely. Because 95% of the sensory requirement for safe driving is visual, good vision of professional drivers is important for safe driving.[9,10] It is essential to know the refractive status of commercial drivers due to its possible contribution to driving-related injuries. Very few studies have been conducted to evaluate the visual skills of commercial drivers, which is an important aspect of their profession.[10-12] This study was conducted to assess the prevalence of refractive errors among commercial drivers in India. This knowledge would be helpful in planning public health strategy for the study population with high occupational injuries.

Methods

This study was an observational descriptive study with convenient sampling. The study was approved by the institutional ethics committee and adhered to the tenets of the Declaration of Helsinki. The study population was commercial drivers available in the study area. Drivers holding a valid commercial light or heavy motor vehicle were included in the study. The study was designed to provide eye care services to commercial drivers at truck parking hubs in various parts of the city. In consultation with representatives of the local truck drivers' associations, a roster was drawn up for eye-screening camps. Posters advertising the initiation of eye-screening camps were distributed and pasted at the walls of truck parking hubs. A total of seven eye-screening camps were organized at major transport hubs, parking lots, road transport offices, bus stands, and schools. All drivers who had given their consent during the study period were included in this study. A team of three optometrists conducted all the procedures at the campsite. All of them have more than 5 years of experience in optometry.

Monocular visual acuity was determined with current spectacle prescription if any. Pinhole acuity was assessed in eyes with presenting visual acuity <20/20 (logarithm of the minimum angle of resolution [logMAR], 0.0). Streak retinoscopy (Beta 200; Heine Optotechnik GMBH & Co. KG, Hersching, Germany) and subjective refraction were performed

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in all subjects. The best-corrected visual acuity was ascertained and recorded.

Emmetropia was defined as a spherical equivalent of −0.50–+0.50 diopter sphere (DS).[13] Myopia was defined as a spherical equivalent of >−0.50 DS,[13-18] Hyperopia was defined as a spherical equivalent of ≥+2.00 DS.[13-18] Astigmatic correction was prescribed in the minus cylinder format, and astigmatism was defined as a cylindrical error of >−0.50 diopter cylinder (DC) in any axis.[13,14,17,18] Astigmatism was defined as with the rule if the axis lay between 15° on either side of the horizontal meridian, against the rule if the axis lay between 15° on either side of the vertical meridian, and oblique if the axis lay between 15° and 75° or between 105° and 165°.[15] A driver was considered myopic if at least one eye was myopic and hyperopic if at least one eye was hyperopic but neither was myopic.

Stereo-fly test was used to measure the drivers' gross and fine depth perception. The Stereo Fly Test was administered according to the manufacturer's instructions. Wearing standard 3D polarized glasses (90° interocular orientation difference), the participants were asked to "pinch the fly's wings." If a participant touched the plate, this established their inability to appreciate the stereoscopic depth, and their outcome was "fail." If the participants pinched the wings above the plate, their outcome was considered a tentative "pass". Schirmer 2 for 3 min was performed for dry eye. Color vision was tested using Ishihara pseudo-chromatic color plate test (24th edition). The test was conducted in a room with optimum natural daylight hours as recommended by Ishihara guidelines. The distance between the subjects being examined and the chart was 75 cm.[19] The test was performed under binocular viewing conditions. The time taken in each plate test was not more than a 3-s delay.

Results

A total of 281 commercial drivers were screened. All of them were males. The average age of drivers was 38.9 ± 10.3 years (range: 18–68 years); of them, 27 (9.6%) were 18–25-years old, 87 (31%) were 26–35-years old, 107 (38.1%) were 36–45-years old, and 60 (21.4%) were more than 45 years old. They were driving for last 1 to 45 years (average: 11.5 ± 7.2 years). Of all, 213 (75.8%) were heavy-vehicle drivers and 68 (24.2%) were light-vehicle drivers. A total of 237 (84.3%) drivers were emmetropic in both eyes.

Refractive errors for distance was reported in 44 (15.7%; 95% CI: 11.6–20.4) drivers. Of them, nine (3.2%; 95% CI: 1.4–5.9) drivers were diagnosed with refractive error for distance in one eye and 35 (12.5%; 95% CI: 8.8–16.9) in both eyes. Hyperopia was reported in 23 (8.2%; 95% CI: 5.2–12) drivers, followed by myopia in 15 (5.3%; 95% CI: 3–8.6) drivers, and astigmatism in six (2.1%; 95% CI: 0.7–4.5) drivers [Table 1]. The average absolute spherical equivalent of right eye was 0.83 ± 0.59 D and of left eye was 0.96 ± 0.64 D. The average age of drivers with refractive error was 42.3 ± 11.9 years and that of drivers without refractive error was 38.2 ± 9.8 years (P = 0.017; independent t test) [Fig. 1].

Among drivers with refractive errors in both eyes, 12 (4.3%) were diagnosed with hyperopia, 10 (3.6%) with myopia, four (1.4%) with simple astigmatism, one (0.35%) with compound hyperopic astigmatism, two (0.7%) with myopia in one eye and compound myopic astigmatism in the other eye, two (0.7%) with hyperopia in one eye and compound hyperopic astigmatism in the other eye, one (0.35%) with myopia in one eye and simple astigmatism in the other eye, one (0.35%) with simple astigmatism in one eye and compound hyperopic astigmatism in the other eye, and one (0.35%) with simple astigmatism in one eye and compound myopic astigmatism in the other eye. Nine (3.2%) drivers were identified with refractive error in one eye. Of them, two (0.7%) were identified with hyperopia, two (0.7%) with myopia, 2 (0.7%) with simple astigmatism, two (0.7%) with compound hyperopic astigmatism, and one (0.35%) with compound myopia astigmatism [Table 2]. A total of 157 (55.8%) drivers were identified with presbyopia. Among emmetropic (for distance) drivers, presbyopia was found in 130 (54.8%) drivers.

Table 1: Refractive error among commercial drivers

Type	Right Eye	Left Eye
Emmeoptric	241 (85.8%)	242 (86.1%)
Hyperopic	21 (7.5%)	19 (6.8%)
Myopic	12 (4.3%)	13 (4.6%)
Simple Astigmatism	7 (2.5%)	7 (2.5%)

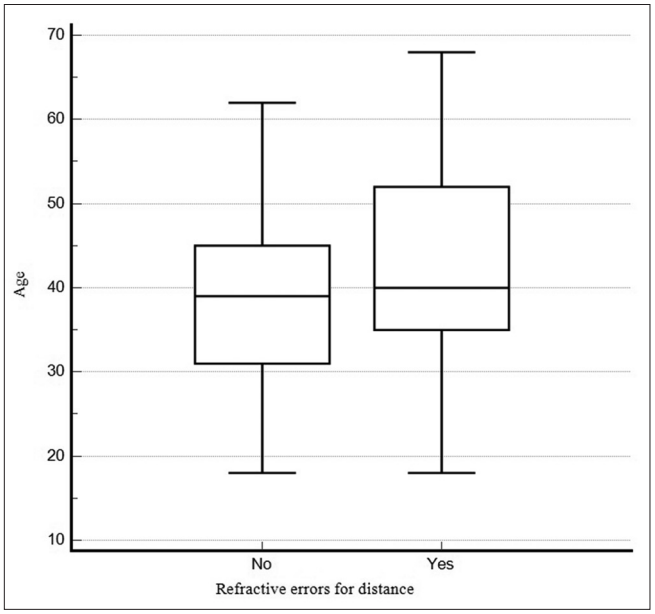

Figure 1: Box plot showing the age distribution of commercial drivers with and without refractive errors

Color vision deficiency was diagnosed in 11 (3.9%; 95% CI: 1.9–6.9) drivers. Three of them were from the 18–25-years age group, two from the 26–35-years age group, three from the 36–45-years age group, and three were more than 45 years of age [Table 3]. A total of 70 (24.9%; 95% CI: 19.9–30.3) drivers were diagnosed with dry eye in at least one eye. Of them, five drivers had severe dry eye in both eyes, 23 with moderate dry eyes in both eyes, six with mild dry eye in both eyes, five with mild in one and moderate in the other eye, one with mild in one and severe in the other eye, and five with moderate in one and severe in the other eye. Three drivers had mild dry eye, 20 had moderate, and two drivers had severe dry eye

Table 2: Eye-wise distribution of refractive errors for distance among commercial drivers

Refractive error for distance	Number	Percentage* (95% Confidence Interval)
Hyperopia (BE)	12	4.2% (2.2-7.3)
Myopia (BE)	10	3.5% (1.7-6.4)
Simple Astigmatism (BE)	4	1.4% (0.3-3.6)
Compound Hyperopic astigmatism	1	0.3% (0.01-1.9)
Myopia and Simple astigmatism	1	0.3% (0.01-1.9)
Myopia and Simple myopia astigmatism	1	0.3% (0.01-1.9)
Myopia and Compound myopic astigmatism	1	0.3% (0.01-1.9)
Simple astigmatism and compound hyperopic astigmatism	2	0.7% (0.09-2.5)
Simple astigmatism and compound myopic astigmatism	1	0.3% (0.01-1.9)
Hyperopia and Compound hyperopic astigmatism	2	0.7% (0.09-2.5)
Hyperopia (SE)	2	0.7% (0.09-2.5)
Myopia (SE)	2	0.7% (0.09-2.5)
Simple astigmatism (SE)	2	0.7% (0.09-2.5)
Compound hyperopia astigmatism (SE)	2	0.7% (0.09-2.5)
Compound myopic astigmatism (SE)	1	0.3% (0.01-1.9)
Total	44	15.6% (11.6-20.%)

(BE): Both Eye; (SE): Single Eye; astigmatism. *Percentage was calculated from the total number of commercial drivers screened for eye diseases (*n*=281)

Table 3: Age-wise distribution of refractive error, color vision, and dry eye

Variable	Category	18-25 Years	26-35 Years	36-45 Years	>45 Years	*P*
Refractive error for distance	Absent	23	77	93	44	0.13
	Both eye	2	9	11	13	
	Single eye	2	1	3	3	
Presbyopia	Yes	0	6	91	60	<0.01
	No	27	81	16	0	
Color-Vision	Normal	24	85	104	57	0.18
	Abnormal	3	2	3	3	
Dry Eye	Present	6	19	26	19	0.57
	Absent	21	68	81	41	

Table 4: Distribution of grades of dry eye between right and left eye of commercial drivers

Dry Eye Category	Right Eye	Left Eye
Normal	218	229
Mild dry eye	11	10
Moderate dry eye	40	36
Severe dry eye	12	6

in one eye only [Table 4]. A total of 77 (27.4%) drivers were stereo-deficient. Three commercial drivers were diagnosed with cataract, and two were referred for retina evaluation.

Discussion

The prevalence of refractive error among commercial drivers was found to be 15.7%. Hyperopia in both eyes was the most common refractive error. Erdoğan *et al*.[20] in their study carried out in Turkey reported that the prevalence of refractive error in heavy vehicle drivers was 21.5%. Keeffe *et al*.[21] reported that 80% of drivers who failed to meet the visual requirements for driving had uncorrected refractive errors. A significant number of commercial drivers in this study were diagnosed with presbyopia. Presbyopia may impact the ability to see the dashboard or navigation system.

Visual performance of commercial drivers is a key for safe driving. Many studies have reported the association between visual acuities and accidents.[22-24] Hills *et al*.[25] reported that among older drivers, visual acuity has been significantly associated with road traffic accidents. In our study too, refractive error was more frequently reported among older drivers. Burton *et al*.[26] reported that 16% of people who held a license failed to meet the driving standard. Our study also reported that most commercial drivers have not undergone routine eye check-ups in the past few years. Qwsley *et al*.[27] reported that visual acuity is weakly associated with accidents. Chu *et al*. reported driving-related difficulties with different correction types (bifocal spectacles, progressive spectacles, monovision contact lenses, multifocal contact lenses).[28] They suggested that correction should be done according to the driving needs.

In this study, dry eye was diagnosed in 24.9% of drivers. Deschamps *et al*.[29] assessed the impact of dry eye disease on visual performance while driving. They reported that the average response time was significantly increased in dry eye

patients as compared to controls. The degradation of ocular optical qualities related to dry eye disease is associated with visual impairments during driving. Dry eyes can cause glare, which can result in reduced quality of vision during driving at night.

In this study, 3.9% of commercial drivers had color vision deficiency. Color vision helps in correctly identifying traffic signals and brake lights. Drivers with color vision deficiency can easily confuse the different signal colors. However, no association between color vision and road traffic accidents has been reported in many previous studies.[30-33] In our study, 27% of commercial drivers were stereo-deficient. The influence of depth perception on driving is not clear. A few earlier studies reported some correlation between stereoscopic acuity and accident rates,[34,35] and driving performance.[36,37] Bauer *et al*.[36] reported that stereopsis has a positive effect on driving performance only in dynamic situations at intermediate distances.

Six drivers were identified with cataract and retina diseases. All of them were referred to a higher center for further evaluation. None of them were presented at a higher institute for further evaluation and management. This was probably due to their mobile nature, unfelt need, and lack of awareness. These can be the major barriers to uptake of available eye care services among commercial drivers. Some limitations of this study are listed as follows. As this was a community-based study, we were not able to perform all ocular assessments at eye screening campsites. The sample size was not calculated previously because this study was conducted at every possible location of commercial driver availability in the study area and among all available drivers who gave their consent to participate were enrolled in the study. The self-reported perceptions of the drivers about their visual symptoms or performance pertinent to driving were not assessed. Also, lifestyle patterns such as history of smoking and alcohol use and history of systemic diseases among commercial drivers were not assessed.

Conclusion

Good eyesight is vital for a commercial driver. Driving involves many aspects of visual function. Many drivers were routinely driving with their compromised vision. More frequent comprehensive eye examination of all drivers is required in the study area. Provision of eye examination facilities near transport hubs of major cities may be one strategy to overcome the barrier to uptake of available eye care services.

Ethical considerations and disclosure(s)

The study was approved by the Institutional Review Board and adhered to the tenets of the Declaration of Helsinki. Inform consent was taken from every participant.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Transportation: India. Available from: https://www.worldbank.org/en/news/feature/2011/09/23/india-transportation#:~:text=India's%20transport%20 sector%20is%20large, is%20 essential%20for%20economic%20growth. [Last accessed 2022 Mar 12].
2. Truck drivers in India. Available from: https://trucksuvidha.com/Truck-Drivers-In-India.aspx. [Last accessed on 2021 Jul 10].
3. Driver shortage for trucking industry – an India perspective: Available from: https://www.iru.org/resources/newsroom/driver-shortage-trucking-industry-india-perspective. [Last accessed on 2021 Jul 10].
4. Sharma PK, Ganguly E. Morbidity profile of long distance truck drivers in Hyderabad city, India. J Dr NTR Univ Health Sci 2014;3:234-7.
5. Ravi R, Abraham G, Ravi R, Mathews M, Partasarathy R. Early detection of renal disease among truck drivers through organized screening. J Family Med Prim Care 2020;9:4880-4.
6. Xia T, Iles R, Newnam S, Lubman D, Collie A. Work-related injury and disease in Australian road transport workers: A retrospective population based cohort study. J Transp Health 2019;12:34-41.
7. Bourne RR, Dineen BP, Huq DM, Ali SM, Johnson GJ. Correction of refractive error in the adult population of Bangladesh: Meeting the unmet need. Invest Ophthalmol Vis Sci 2004;45:410-7.
8. Naidoo KS, Jaggernath J. Uncorrected refractive errors. Indian J Ophthalmol 2012;60:432-7.
9. Taylor JF. Vision and driving. Practitioner 1982;226:885-9.
10. Ovenseri-Ogomo G, Adofo M. Poor vision, refractive errors and barriers to treatment among commercial vehicle drivers in the Cape Coast municipality. Afr Health Sci 2011;11:97-102.
11. Boadi-Kusi SB, Kyei S, Asare FA, Owusu-Ansah A, Awuah A, Darko-Takyi C. Visual function among commercial vehicle drivers in the central region of Ghana. J Optom 2016;9:54-63.
12. Mechergui N, Bouladi M, Ben Osman I, Ladhari N, Youssef I, El Fekih L. Visual disorders and fitness for professional driving. Tunis Med 2020;98:480-7.
13. Wong TY, Foster PJ, Hee J, Ng TP, Tielsch JM, Chew SJ, *et al*. Prevalence and risk factors of refractive errors in adult Chinese in Singapore. Invest Ophthalmol Vis Sci 2000;41:2486-94.
14. Dandona R, Dandona L, Naduvilath TJ, Srinivas M, McCarty CA, Rao GN. Refractive errors in an urban population in Southern India: The Andhra Pradesh eye disease study. Invest Ophthalmol Vis Sci 1999;40:2810-8.
15. Attebo K, Ivers RQ, Mitchell P. Refractive errors in an older population: The Blue Mountains eye study. Ophthalmology 1999;106:1066-72.
16. Wang Q, Klein BEK, Klein R, Moss SE. Refractive status in the Beaver Dam eye study. Invest Ophthalmol Vis Sci 1994;35:4344-7.
17. Katz J, Tielsch JM, Sommer A. Prevalence and risk factors for refractive errors in an adult inner city population. Invest Ophthalmol Vis Sci 1997;38:334-40.
18. Wu SY, Nemesure B, Leske MC. Refractive errors in a black adult population: The Barbados eye study. Invest Ophthalmol Vis Sci 1999;40:2179-84.
19. Karim JK, Salem MA. Prevalence of congenital red-green color vision defects among various ethnic groups of students in Erbil City. Jordan J Biol Sci 2013;6:235-7.
20. Erdoğan H, Özdemir L, Arslan S, Cetin I, Ozeç AV, Cetinkaya S, *et al*. Prevalence of refraction errors and color blindness in heavy vehicle drivers. Int J Ophthalmol 2011;4:319-22.
21. Keeffe JE, Jin CF, Weih LM, McCarty CA, Taylor HR. Vision impairment and older drivers: Who's driving? Br J Ophthalmol 2002;86:1118-21.
22. Ball K, Owsley C, Sloane ME, Roenker DL, Bruni JR. Visual attention problems as a predictor of vehicle crashes in older drivers. Invest Ophthalmol Vis Sci 1993;34:3110-23.
23. Davison PA. Inter-relationships between British drivers' visual

abilities, age and road accident histories. Ophthalmic Physiol Opt 1985;5:195-204.

24. Marottoli RA, Richardson ED, Stowe MH, Miller EG, Brass LM, Cooney LM Jr, *et al*. Development of a test battery to identify older drivers at risk forself-reported adverse driving events. J Am Geriatr Soc 1998;46:562-8.
25. Hills BL, Burg A. Crowthorne, England: Transport and Road Research Laboratory; 1977. A Reanalysis of California Driver Vision Data: General Findings. Available from: https://journals.sagepub.com/doi/pdf/10.1068/p090183. [Last accessed on 2022 Mar 12].
26. Burton BJ, Joseph J. Changing visual standards in driving: But a high proportion of eye patients still drive illegally. Br J Ophthalmol 2002;86:1454-5.
27. Owsley C, Stalvey BT, Wells J, Sloane ME, McGwin G Jr. Visual risk factors for crash involvement in older drivers with cataract. Arch Ophthalmol 2001;119:881-7.
28. Chu BS, Wood JM, Collins MJ. Effect of presbyopic vision corrections on perceptions of driving difficulty. Eye Contact Lens. 2009 May;35(3):133-43. doi: 10.1097/ICL.0b013e3181a1435e. PMID: 19421020.
29. Deschamps N, Ricaud X, Rabut G, Labbé A, Baudouin C, Denoyer A. The impact of dry eye disease on visual performance while driving. Am J Ophthalmol 2013;156:184-9.
30. Cole BL. Protan colour vision deficiency and road accidents. Clin Exp Optom 2002;85:246-53.
31. Cole BL, Maddocks JD. Defective colour vision is a risk factor in driving. **In: Cavonius CR, editor**. Colour Vision Deficiencies XIII. Dordrecht: Kluwer; 1997.
32. Pepple G, Adio A. Visual function of drivers and its relationship to road traffic accidents in Urban Africa. Springerplus 2014;3:47. doi: 10.1186/2193-1801-3-47.
33. Norman LG. Medical aspects of road safety. Lancet 1960;275:1039-45.
34. Gresset JA, Meyer FM. Risk of accidents among elderly car drivers with visual acuity equal to 6/12 or 6/15 and lack of binocular vision. Ophthalmic Physiol Opt 1994;14:33-7.
35. Humphriss D. Three South African studies on the relation between road accidents and drivers' vision. Ophthalmic Physiol Opt 1987;7:73-9.
36. Bauer A, Dietz K, Kolling G, Hart W, Schiefer U. The relevance of stereopsis for motorists: A pilot study. Graefes Arch Clin Exp Ophthalmol 2001;239:400-6.
37. McKnight AJ, Shinar D, Hilburn B. The visual and driving performance of monocular and binocular heavy-duty truck drivers. Accid Anal Prev 1991;23:225-37.