Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 27s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Refractive Errors and Ocular Morbidity Among Commercial Drivers in North Delhi: A Cross-Sectional Study

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Cite this paper as: Shivam Tayal, Krishna Kumar Gupta, (2025) Refractive Errors and Ocular Morbidity Among Commercial Drivers in North Delhi: A Cross-Sectional Study. *Journal of Neonatal Surgery*, 14 (27s). 1087-1094

ABSTRACT

Background: Visual impairment poses a significant global public health concern, with substantial implications for road safety. Refractive errors are a leading cause of visual impairment worldwide, and their impact on commercial drivers, who require optimal vision for safe operation of vehicles, warrants specific attention. Road traffic injuries are a major cause of mortality and morbidity globally, and visual impairment is recognized as a contributing risk factor. While studies have examined the prevalence of visual impairment in various populations in India, data specific to commercial drivers in North Delhi remain limited.

Methods: A descriptive cross-sectional study was conducted between December 2023 and March 2024 to screen commercial heavy-vehicle drivers at mobile eye camps stationed in key truck-parking locations across North Delhi. Using convenience sampling, 2,541 licensed drivers were enrolled. Comprehensive eye examinations were carried out by a trained optometrist, including monocular visual acuity assessment with logMAR charts, both objective and subjective refraction, objective refraction, fundus photography, and color vision testing. Refractive errors were defined as myopia of ≤ -0.50 diopters (D), hyperopia of $\geq +0.50$ D, or astigmatism with a cylindrical error of ≥ 0.50 D. Presbyopia was identified as near vision worse than N6 at 40 cm that required an addition of at least +1.00 D. Drivers diagnosed with uncorrected refractive errors were provided with spectacles at no cost. Data were analyzed using Microsoft Excel 2013, and prevalence estimates were reported with corresponding 95% confidence intervals (CIs)

Results: The study population had a mean age of 38.7 ± 8.9 years (range: 18–60 years), with 99% identifying as male. The overall prevalence of uncorrected refractive errors (ametropia) was 9.9% (252 out of 2,541; 95% CI: 8.8–11.1). Among these, astigmatism was the most prevalent (5.03%), followed by hyperopia (3.97%) and myopia (0.90%). Presbyopia was observed in 42.7% of participants (1,084/2,541), with a significant age-related increase noted beyond 40 years ($p < 0.001$). Regarding ocular morbidity, cataract emerged as the most common pathology (2.79%), followed by retinal abnormalities (0.47%) and suspected glaucoma cases (0.19%). Despite these findings, only 14% of drivers reported ever having undergone an eye examination. Among those identified with refractive errors and offered corrective lenses, 91% accepted and received spectacles.

Conclusion: Uncorrected refractive errors affected approximately one in ten commercial drivers in North Delhi, and presbyopia was present in more than 40% of the cohort. Additionally, a notable proportion exhibited potentially sight-threatening ocular conditions. Implementing mobile eye screening programs with immediate on-site spectacle provision proves to be an effective approach for enhancing visual health and potentially improving road safety within this high-risk occupational population.

Keywords*:* *commercial drivers; refractive error prevalence; occupational eye health.*

1. INTRODUCTION

Road traffic crashes represent a major global public health challenge, resulting in approximately 1.19 million deaths annually and leaving between 20 and 50 million people with non-fatal injuries.1 These incidents are the leading cause of death for children and young adults aged 5–29 years.2 The economic consequences are also substantial, with road traffic crashes costing most countries 3% of their gross domestic product. Among the various factors contributing to road traffic accidents, visual impairment is increasingly recognized as a significant risk.3 Globally, refractive error is a leading cause of vision impairment, affecting millions of individuals and contributing to a substantial economic burden estimated at US$202 billion annually due to uncorrected refractive errors.4 In the Indian context, road safety is a critical concern, with the country accounting for a disproportionately high number of road crash deaths despite having only a small percentage of the world's vehicles.5 Statistics indicate that a significant number of fatalities and injuries occur on Indian roads annually. Studies suggest that over half of the Indian drivers responsible for road accidents have at least one vision disability, highlighting the critical role of driver vision in road safety.5 The global prevalence of refractive error is substantial, with estimates indicating that billions of people are affected.4 Similarly, various ocular diseases contribute significantly to visual impairment worldwide.

Safe driving depends on rapid detection and accurate interpretation of visual stimuli, functions compromised by uncorrected refractive error and ocular pathology.6 Globally, road traffic injuries rank eighth among causes of death, and visual impairment contributes significantly to crash risk.7 In India, commercial heavy vehicle drivers cover long distances under challenging conditions—glare, dust, night driving and irregular schedules—that exacerbate visual fatigue.8 Studies from southern and western India reported ametropia prevalences of 7–12 % in such drivers 9, yet data from the National Capital Region (NCR) remain sparse. While data on the prevalence of visual impairment in the general Indian population are available10 , there is a relative lack of specific information regarding the visual health status of commercial drivers, particularly in the North Delhi region. Occupations such as driving place significant demands on visual function, requiring adequate static and dynamic visual acuity, field of vision, and color perception.11 Given the critical role of commercial drivers in transportation and logistics, understanding the prevalence of refractive errors and ocular diseases in this population is essential for addressing road safety concerns and promoting public health. Several studies conducted in India between 2020 and 2024 have provided insights into the prevalence of refractive errors and ocular diseases among commercial drivers in different parts of the country.11

Occupational health programmes seldom prioritise eye care, and cost, poor awareness and time constraints deter drivers from seeking examinations.12 Untreated hyperopia impairs distance judgement, astigmatism degrades image clarity, and presbyopia hampers instrument panel reading .13 Cataract and glaucoma, often asymptomatic initially, may progress to irreversible loss. Evidence suggests that even mild visual impairment raises crash risk by 30 40 % .14 North Delhi hosts several large transport terminals servicing interstate freight. The constant influx of drivers offers an opportunity to integrate vision screening into occupational outreach. We therefore investigated the prevalence and spectrum of refractive errors and ocular morbidity among commercial drivers in North Delhi, hypothesising that rates would mirror or exceed those reported elsewhere in India. Findings aim to inform targeted interventions and policy for mandatory periodic eye examinations. However, there remains a need for region-specific data, especially for a densely populated and commercially significant area like North Delhi. This study aims to address this gap by determining the prevalence of refractive errors and ocular diseases among commercial drivers operating in North Delhi, India. The findings of this research will provide valuable data for informing targeted interventions and policies aimed at improving the visual health and safety of this occupational group and contributing to overall road safety in the region.

2. MATERIALS AND METHODS

This study employed a cross-sectional design to investigate the prevalence of refractive errors and ocular diseases among commercial drivers in North Delhi, India. The study was conducted over a defined period from December 2023 to March 2024 to capture a representative snapshot of the visual health of this population. Participants included licensed commercial drivers actively operating various types of commercial vehicles within the geographical boundaries of North Delhi. Drivers were recruited through collaborations with transport associations, licensing authorities, and at designated transport hubs within the study area. The inclusion criteria comprised holding a valid commercial driving license and actively driving a commercial vehicle in North Delhi during the study period. Drivers with a history of ocular surgery within the past six months or those unwilling to provide informed consent were excluded from participation. A comprehensive eye examination protocol was followed for each participant. This included assessment of distance and near visual acuity using standardized Snellen charts. Refraction was performed using both objective (retinoscopy) and subjective methods to determine the refractive error. The spherical equivalent was calculated to categorize refractive errors into myopia (spherical equivalent $\leq$ -0.50 diopters), hyperopia (spherical equivalent $\geq$ +0.50 diopters), and astigmatism (cylindrical power $\geq$ 0.50 diopters). Presbyopia was defined as the need for a near addition of $\geq$ +1.00 diopter in individuals aged 40 years and above. A thorough anterior segment examination was conducted using a torch light to screen for conditions such as cataract,

pterygium, and conjunctival abnormalities. Posterior segment evaluation was performed using direct ophthalmoscopy to assess the retina, optic nerve head, and macula for diseases like glaucoma and diabetic retinopathy. Participants were also questioned about any history of ocular conditions or symptoms such as dry eye. Ethical approval for this study was obtained from the institutional review board of GD Goenka University (Ref: GO/OPT/2023/11). Prior to participation, each driver was provided with detailed information about the study procedures, potential risks and benefits, and their right to withdraw at any time without penalty. Written informed consent was obtained from all drivers who agreed to participate in the study. Statistical analysis was performed using appropriate software. Prevalence rates for overall refractive errors, specific types of refractive errors (myopia, hyperopia, astigmatism, presbyopia), and various ocular diseases were calculated as the proportion of affected individuals within the study sample, along with their 95% confidence intervals. Prevalence data were also analyzed across different age groups and other relevant demographic variables using statistical tests such as the chi-square test to identify any significant associations.

3. RESULTS

Of the 2,613 eligible commercial drivers approached, 2,541 (97.2%) participated in the study and were successfully examined. The mean age of the participants was 38.7 ± 8.9 years, with a predominant male representation (98.9%). A significant majority (63%) reported driving more than 8 hours per day, highlighting the high visual demand of their occupation. In terms of visual status, 43.2% of the drivers were found to be emmetropic, 9.9% had ametropia requiring distance correction, and 42.7% were presbyopic. Notably, there was an overlap of 5.2% of participants who exhibited both ametropia and presbyopia. Among refractive errors, astigmatism was the most prevalent, affecting 5.03% of drivers, followed by hyperopia (3.97%) and myopia (0.90%). Specifically, compound hyperopic astigmatism was the most common form (1.92%), while simple myopic and compound myopic astigmatism accounted for 1.49% and 1.21%, respectively. Presbyopia showed a clear age-related trend, affecting 18% of drivers under 35 years and increasing to 74% among those aged 50 years and above. Apart from refractive errors, ocular morbidities were identified in 108 drivers (4.3%). Cataract, defined as any lens opacity, was the most common pathology and was observed in 2.79% of participants. Other findings included retinal lesions (0.47%), glaucoma suspects based on intraocular pressure >21 mmHg or a cup-to-disc ratio >0.6 (0.19%), corneal pathologies (0.35%), strabismus (0.19%), and color vision deficiency (0.23%). Among the 252 drivers diagnosed with distance ametropia, 229 (90.9%) accepted free spectacles when offered, reflecting a high level of uptake. However, prior utilization of eye care services was low, with only 14% of all participants reporting an eye examination within the past two years. These findings highlight a considerable burden of uncorrected refractive errors and ocular morbidities, as well as gaps in access to routine vision care among commercial drivers

TABLE 1. VISUAL STATUS AMONG COMMERCIAL DRIVERS (N = 2 541)

Category	n	%
Emmetropic	1 097	43.17
Ametropic (distance)	252	9.92
Presbyopic (near)	1 084	42.66

TABLE 2. DISTRIBUTION OF REFRACTIVE ERRORS (BOTH EYES COMBINED)

Error type	n	% of drivers
Hyperopia	101	3.97
Myopia	23	0.90
Astigmatism (all)	128	5.03

– Simple myopic astigmatism	38	1.49
– Compound myopic astigmatism	31	1.21
– Simple hyperopic astigmatism	10	0.39
– Compound hyperopic astigmatism	49	1.92

TABLE 3. OCULAR DISEASES DETECTED

Condition	**N**	**%**
Cataract (any opacity)	71	2.79
Retinal lesions†	12	0.47
Glaucoma suspects‡	5	0.19
Corneal pathology	9	0.35
Colour-vision deficiency	6	0.23
Strabismus	5	0.19

† diabetic or hypertensive retinopathy, lattice degeneration;

‡ Cup–disc ratio > 0.6.

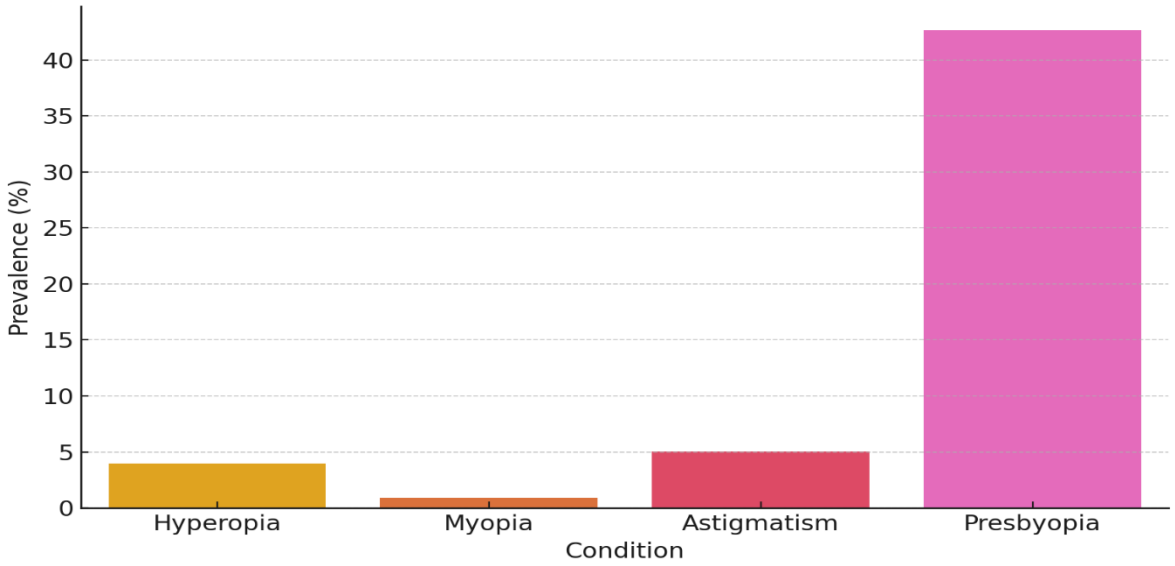

Figure 1: Prevalence of major refractive errors and presbyopia

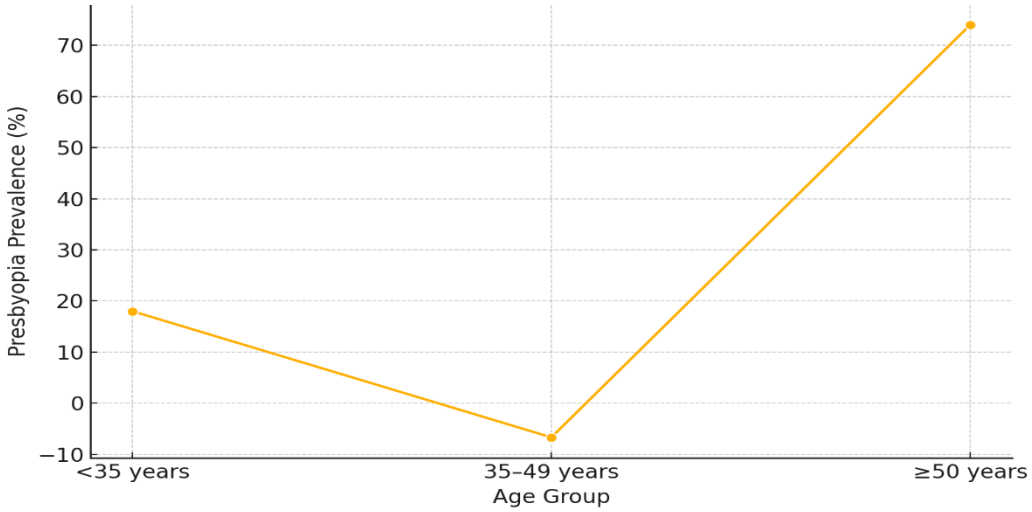

Figure 2. Age-wise trend of presbyopia prevalence among drivers

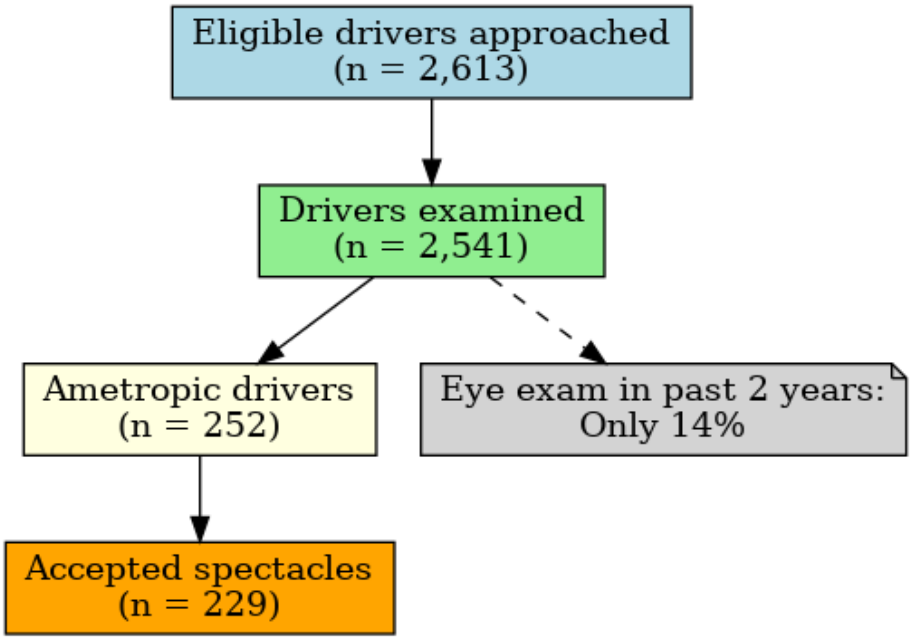

Figure 3. Flow diagram of screening outcomes and spectacle

4. DISCUSSION

The findings of this study on commercial drivers in North Delhi can be compared with existing research conducted both in India and globally. Studies in India between 2020 and 2024 have shown a considerable variation in the prevalence of refractive errors among commercial drivers.11 For instance, the prevalence of any refractive error has been reported to range from 15.7% to 45.0% across different studies, and presbyopia prevalence has been found to be as high as 55.8% in North India. This study documents a 9.9 % prevalence of uncorrected ametropia and a striking 42.7 % prevalence of presbyopia among commercial drivers in North Delhi. The overall refractive error burden aligns with findings from Karnataka (11.2 %) 15 and Maharashtra (8.7 %) 16, yet presbyopia rates here surpass the 30–35 % reported in comparable age matched cohorts .17 Globally, studies have also highlighted the significant burden of uncorrected refractive errors.18 The Yazd Eye Study, for example, reported prevalence rates for myopia, hyperopia, and astigmatism in the general population.19 Variations in prevalence rates across different studies could be attributed to differences in study populations, age ranges of participants, methodologies employed, and diagnostic criteria used. The current study in North Delhi reveals

a relatively high prevalence of hyperopia, this finding align with some Indian studies that have identified hyperopia as a common refractive error among commercial drivers. A higher prevalence of hyperopia among drivers could have significant implications for road safety, as it can affect distance vision, which is crucial for tasks such as reading road signs and judging distances.20 Similarly, a high prevalence of presbyopia, as observed in other Indian studies , would impact the near vision of drivers, potentially affecting their ability to read dashboard instruments and maps.21 The prevalence of other refractive errors like myopia and astigmatism, as well as ocular diseases such as cataract, glaucoma, and dry eye, are found to be significant in the North Delhi population, would also warrant attention due to their potential to impair driving ability. Notably, myopia was low (0.9 %), contrasting with the burgeoning myopia epidemic in urban Indian youth.13 Occupational selection may partly explain this, as high uncorrected myopia could preclude licensure. The cataract prevalence (2.8 %) resembles that in Thai freight drivers 22; chronic UV exposure and poor sunglass use likely contribute. Although glaucoma suspects were few (0.2 %), any missed cases pose substantial public safety risks given glaucoma's insidious progression .23 Only 14 % of participants had undergone prior eye examination, echoing similar gaps in preventive care highlighted by Wadhwani et al.24 Free, on site spectacles achieved > 90 % uptake, reinforcing cost and convenience as modifiable barriers. Our camp model—which coupled screening, refraction and dispensing in a single visit—addresses these barriers effectively and could be scaled through public–private partnerships.

Strengths include a large sample and comprehensive ocular assessment using objective imaging. Limitations stem from convenience sampling and absence of a control group; extrapolation beyond North Delhi should be cautious. Visual field testing was not feasible in the mobile setting, possibly under estimating glaucoma. Long term adherence to glasses and impact on crash rates were outside the study scope but warrant prospective evaluation.25 This study, like all research, would have certain limitations. These could include the sampling method used, which might introduce some bias, the cross-sectional nature of the study, which provides a snapshot of prevalence at a single point in time, and potential limitations in data collection. However, the study would also have strengths, such as its specific focus on commercial drivers in North Delhi, a population that has not been extensively studied, and the use of a comprehensive eye examination protocol. The findings of this research have important policy implications. If a significant proportion of commercial drivers in North Delhi are found to have uncorrected refractive errors or ocular diseases, it would underscore the need for mandatory vision screening programs at the time of obtaining and renewing commercial driving licenses.

The findings support recommendations by the International Labour Organization and India's Central Motor Vehicle Rules for periodic vision testing of commercial drivers.26 We advocate mandatory biennial eye examinations, employer subsidised eyewear, and health education modules underscoring the link between vision and road safety. Future research should quantify cost effectiveness and explore tele optometry for remote hubs.27 Policies could also focus on improving access to affordable vision correction and eye care services for commercial drivers. Future research could explore the impact of vision correction on the accident rates among commercial drivers in North Delhi through longitudinal studies. Further investigations could also delve into the specific visual demands of different types of commercial driving and the effectiveness of various vision screening protocols for this occupational group.

5. CONCLUSION

Uncorrected refractive errors and presbyopia are common among commercial drivers in North Delhi, while treatable ocular diseases such as cataract remain under detected. Mobile vision camps proved effective in identifying and correcting defects, with high spectacle acceptance rates. Integrating routine ocular screening into occupational health policies will enhance drivers' visual fitness and likely reduce road traffic injuries. Tailored interventions—including on site refraction, affordable spectacles and referral pathways for cataract and glaucoma—should be prioritised to safeguard both drivers and the wider public. The prevalence of refractive errors and ocular diseases among commercial drivers in North Delhi, India, as determined by this study, carries significant implications for both the visual health of these drivers and the safety of the roads they navigate. The findings emphasize the importance of addressing visual impairment in this high-risk occupational group through targeted public health interventions and policy changes. Ensuring that commercial drivers have optimal vision is crucial for preventing road traffic accidents and promoting overall public safety.

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