Examining the FMCSA Vision Standard for Commercial Motor Vehicle Drivers

The objective of this study was to determine the safety efficacy of current Federal Motor Carrier Safety Administration (FMCSA) visual performance standards for commercial motor vehicle (CMV) drivers. The research team procured a dataset from a third-party provider (TPP) that included all vision-related data obtained during Department of Transportation (DOT) medical examinations for nearly 200,000 CMV drivers from six carriers. This data was merged with crash records from the Motor Carrier Management Information System (MCMIS) provided by FMCSA. Note that the MCMIS dataset does not include information on driver fault or the cause of the crash.

STUDY DESIGN

This study addressed a series of research questions, including:

1. Is monocular vision associated with increased crash risk?
2. Do red-green color deficiencies increase crash risk?
3. Is visual field loss, as defined in the current guidelines, associated with an increase in crash risk?
4. Is visual acuity worse than 20/40 associated with an increase in collision rate?
5. What other visual performance measures related to driving should be evaluated, if any?

To address these questions, the research team conducted a literature review; consulted with vision experts; and analyzed vision-related DOT medical examination data and crash records for 19,468 CMV drivers within the timeframe (from January 3, 2005, to December 30, 2016). A cohort study design was used, given that the dataset contained pre-existing measurements of potential risk factors from DOT medical examination records. These data were merged with crash records in MCMIS. Only those collisions occurring subsequent to the DOT medical examination were used in the analysis.

RESULTS

Literature Review

The literature review evaluated predictors of crash risk among a list of candidate measures. Two measures consistently rise to the top as having the strongest associations with crash risk: contrast sensitivity and useful field of view. While contrast sensitivity[1,2,3] and useful field of view[4,5,6] have been shown to be associated with increased crash risk in many studies, they have not been evaluated in large samples of CMV drivers, although they have been evaluated in a few smaller studies, including one on commercial drivers.[7] Visual field sensitivity also has some consistent associations with crash involvement; however, the methods used in many studies for evaluating the visual field are inadequate. Other measures have been used in research, but are not feasible or well-developed enough at this time for translation into a clinical setting. These include measures of vection (optical flow), dark focus, and glare sensitivity.

Based on the findings of this review, the research team concluded that the most feasible and valid additional measures of visual performance for driving safety that are not currently evaluated for commercial drivers are contrast sensitivity and useful field of view.

Expert Consultations

Interviews were conducted with eight medical experts (including representatives from the fields of ophthalmology, optometry, medicine, and the CMV industry, as well as professors in academic departments and traffic and safety officials) to better understand views and issues related to vision requirements for the safe operation of CMVs.

Descriptive findings indicated differences in opinion by individuals actively performing DOT medical examinations versus vision scientists, physicians in other related fields, and ophthalmologists. Vision scientists and ophthalmologists seemed to indicate a lack of data to provide evidence of crash risk, or they disagreed with several of the visual conditions assessed, citing accommodations or compensatory strategies often employed by individuals to overcome such conditions (e.g., surgery for cataracts).

Interestingly, the two visual performance measures deemed most important by consulted experts to include in the medical evaluation—contrast sensitivity and useful field of view—were also the two measures identified through the literature review. A common theme among participants revealed a need for additional data to support changes to the current regulations for CMV drivers.

Statistical Analysis

Findings from the statistical analysis of DOT medical examinations and crash records are presented in Table 1.

Results showed that individuals with visual acuity worse than 20/40 in their better eye, or in both eyes, had a significantly higher collision rate than those with visual acuity of 20/40 or better in their better eye, or in both eyes. Collision rates were also elevated for those drivers with horizontal field of view less than 70 degrees in their right eye. Note that these CMV drivers (1) failed to meet FMCSA's current standards for visual acuity and horizontal field of vision, and (2) failed to meet the visual acuity eligibility requirements for obtaining a vision exemption from FMCSA. There was no evidence that those with monocular vision, nor those with impaired color vision, were at increased risk of collision.

STRENGTHS AND LIMITATIONS

The strengths of this analysis include the large number of medical examinations provided in the third-party database, and the ability to link these examinations with the MCMIS dataset provided by FMCSA.

While the third-party dataset is relatively large, it is limited to six carriers that use the services offered by the third-party provider. Therefore, the data are not from a nationally representative sample of CMV drivers.

Separately, it was not known whether the CMV driver was at fault in the crashes evaluated. This further weakens associations between visual function measures and crash risk.

Finally, there are many potential reasons for collisions, including (for example) medical conditions or declining physical or cognitive function. Since the cause of a crash is not identified in the MCMIS dataset, it is not possible to know whether visual function specifically was the cause of the crash.

CONCLUSION

Evidence from the literature review, consultation with experts, and safety analysis of DOT medical examination and MCMIS crash data support the measurement of visual acuity and horizontal field of view using the current cut-points. The safety analysis did not find that monocular CMV drivers were experiencing an increased crash risk relative to binocular CMV drivers or that those drivers who did not pass the color vision screening were experiencing an increased crash risk. These comparisons, however, were based on very low numbers of drivers exhibiting those impairments.

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Table 1. Collision rates, rate ratios and 95-percent confidence intervals for visual function measurements.

Visual Function Measurements	No. (%) of Drivers	No. Crashes	Person Years	Collision Rate per 100 Person-Years	Rate Ratio (95% Confidence Interval)	*p*-value
Acuity - Better Eye						
20/40 or better	128,405 (96.3)	10,174	607,137	1.68	–	–
Worse than 20/40	4,884 (3.7)	414	22,086	1.87	1.12 (1.01-1.23)	0.03*
Acuity - Worse Eye						
20/40 or better	119,777 (89.9)	9,570	568,243	1.68	–	–
Worse than 20/40	13,512 (10.1)	1,018	60,979	1.67	0.99 (0.93-1.06)	0.79
Acuity - Both Eyes						
Both eyes 20/40 or better	119,777 (89.9)	9,570	568,243	1.68	–	–
One eye worse than 20/40	8,628 (6.5)	604	38,894	1.55	0.92 (0.85-1.00)	0.05
Both eyes worse than 20/40	4,884 (3.7)	414	22,086	1.87	1.11 (1.01-1.23)	0.03*
Horizontal Field of View – Right Eye						
<70 degrees	2,077 (1.6)	206	10,659	1.93	1.15 (1.00-1.32)	0.04*
≥70 degrees	131,222 (98.4)	10,383	618,624	1.68	–	–
Horizontal Field of View – Left Eye						
<70 degrees	2,359 (1.8)	212	11,863	1.79	1.07 (0.93-1.22)	0.36
≥70 degrees	130,940 (98.2)	10,377	617,420	1.68	–	–
Horizontal Field of View – Both Eyes						
Neither eye <70 degrees	130,685 (98.0)	10,348	616,038	1.68	–	–
One eye <70 degrees	792 (0.6)	64	3967	1.61	0.96 (0.75-1.23)	0.74
Both eyes <70 degrees	1,822 (1.4)	177	9277	1.91	1.14 (0.98-1.32)	0.09
Recognizes Colors						
Yes	133,110 (99.9)	10,575	628,309	1.68	–	–
No	189 (0.1)	14	973	1.44	0.85 (0.51-1.44)	0.56
Monocular Vision						
No	132,908 (99.7)	10,563	627,342	1.68	–	–
Yes	391 (0.3)	26	1,940	1.34	0.80 (0.54-1.17)	0.25

* Statistically significant.
– Comparison group.

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