VALIDITY OF VISION SCREENINGS AT DRIVERS LICENSE RENEWALS

by

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ABSTRACT

Background: An analysis of data collected from state department of transportation websites was utilized to analyze whether or not states with frequent vision screenings required for those over 65 see lower accident rates than states that do not screen for vision at any license renewal. Literature was reviewed to discuss the implications vision has on driving and other possible options for licensure vision testing. *Methods:* Data was collected via an internet search using department of transportation data and national highway traffic safety administration data from 2015. The information that was collected included accident rates in the population 65 and older. This data was analyzed by placing states in one of two groups: states that do not require vision screening at renewal and states that require a vision screening at renewal every 5 years or less. *Results:* By running an unpaired t-test, no statistically significant difference was found between the two testing groups (no vision screening required and vision screening required within 5 years). *Conclusions*: Visual acuity and visual field testing that is currently used widely by state department of motor vehicle offices does not appear helpful for reducing accident rates in drivers over 65 years old. There are many other options for assessing driver safety such as useful field of view, contrast sensitivity, and driving simulations that should be considered.

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CHAPTER 1

INTRODUCTION

Data collected in the 2016 census shows that around 42 million drivers on the road are over the age of 65.[1] Drivers over the age of 65 are most likely to be involved in a fatal crash per mile driven.[1] Older drivers are also more likely to be injured in car accidents in comparison to other age groups.[2] This is likely due to the fact that older drivers are more likely to be involved in accidents involving multiple cars and complex driving situations, such as busy intersections, left turns, and merging.[2] Despite the wide variety of large and small studies on the impacts of vision and driving, the results vary greatly. There are studies that show visual acuity has no impact on crash rates and there are studies with opposite results.[2,4,8] Due to the many variables that affect older drivers, it is hard to narrow down vision as a sole reason for motor vehicle accidents.[2] There is some evidence that suggests that older drivers, especially those with visual impairments, tend to self-regulate which may skew results of some studies. With the ability to make their own schedule thanks to retirement, the aging population can limit their driving to good weather and day light hours. [3] Due to the fact that the aging population is becoming one of the faster growing groups of drivers, it is important to make sure they are safe when on the road. [2]

Vision and driving

Multiple studies reviewed by Owlsey and McGwin, show conflicting results when it comes to the role of visual acuity and accident rates in driving.[4] Drivers with loss of visual acuity do tend to struggle in one area, reading road signs. Road signs are designed for drivers with 20/30 or better binocular acuity but ability to read road signs is not consistent with driver safety. [4] The Blue Mountain study showed that when adjusting for amount of time spent on the road, accident rates were higher in those 79 years or older.[5] Other studies show only a weak correlation between visual acuity and accident rates when organized by age.[2] It is difficult to relate accident rates specifically to visual acuity when many other variables affect older adult's ability to drive. Drivers over the age of 65 may have difficulty with visual field, contrast sensitivity and dividing attention.[4]

Visual driver license requirements in the United States

Currently, in the United States, only 16 percent of states require a vision screening at license renewals.[6] Of the states that require a vision test at license renewal, the majority of states only use visual acuity to assess a patient's driving ability as it relates to vision.

Visual acuity has long been the standard for assessing the impact eye health has on a person's ability to see. This is why it was adopted by states for assessing the visual ability of those seeking their drivers liscense.[4] Despite studies showing that visual acuity does not correlate well with accident rates, it does play an important role in driving. In the United States road signs are designed assuming drivers have at least 20/30 or better binocular visual acuity, giving them enough time to adequately respond to the

information on the sign.[4] The problem with this is that the ability to read a sign and react does not necessarily mean a driver can't continue to maneuver familiar roads with poor acuity. Regardless of the standard acuity needed to read road signs, there is vast variability between states when it comes to license requirements. The majority of states require 20/40 or better in at least one eye but a handful of states such as Arkansas, Maryland, and Georgia are less strict with a 20/60 requirement.[6]

Research by Owsley and McGwin looked into the validity of the use of visual fields as a requirement for licensure. Even when controlling for driving exposure, drivers with visual field impairment did not have a reported increase in motor vehicle accidents.[4] Similar to visual acuity, the study results vary. Multiple studies have shown an association between visual field loss and motor vehicle accidents but it was only statistically significant when the visual field loss was significant. [4] This same report did note that patients with a sudden visual field loss, compared to long standing or gradual loss, were more likely to be involved in car accidents.[4] Regardless of the research having variable results, the majority of states, 62%, require varying degrees of binocular or monocular visual field for receiving or maintaining a driver's license.[6] Results from these studies prompt a more effective measurement of field of view as it relates to vision and driving.

Visual difficulties that affect older drivers

Cataracts, glaucoma and macular degeneration are the most common ocular diseases that impact vision in the elderly. Over 40 percent of Americans over the age of 75 have cataracts and the impact on vision can range from glare to severe vision loss.[7]

The typical visual difficulty cataracts cause is loss of contrast sensitivity.[7] One study by Owsley and McGwin found that drivers with loss of visual acuity were more likely to self-regulate.[4] The same was not seen in patients with normal acuity but loss of contrast sensitivity, as drivers with loss of contrast did not adjust driving habits.[4] Despite contrast sensitivity not currently being tested at departments of motor vehicles, it has a profound impact when it comes to safety and driving. Drivers with loss of contrast sensitivity were eight times more likely to be involved in a crash than age matched adults.[7] One study by Wood, Watson and King found that despite cataract patients being aware of their visual difficulties, no reported difficulty with driving was reported despite that group having a higher crash rate than the control.[7]

Although glaucoma only affects 4.5% of people 60-69, the loss of peripheral field sensitivity can have negative impacts on driving.[7] One study found that despite having impaired visual fields, the majority of drivers with glaucoma still rated themselves as having good vision as it related to driving. This study showed a mismatch in the reality and perception of drivers with both glaucoma and cataracts.[7] Despite this, there is no consensus to back up the claims that drivers with glaucoma are more likely to get into car accidents.[8] One study that looked at motor vehicle accident risk in glaucoma patients based on standard automated perimetry versus useful field of view found that there was only a weak correlation with standard perimetry but more correlation with the useful field of view.[9]

Around 11 million Americans suffer from age related macular degeneration which causes loss of central vision, difficulty in low light situations, and loss of contrast sensitivity.[10] Although this is a large population of people, there are not many current

studies on the impacts ARMD has on driving. Of the few studies performed, they demonstrate a decrease in driving performance in ARMD patients on simulated road tests.[11] Even early on in the disease the problems such as dark adaptation delays and poor contrast sensitivity may impact driving. When surveyed, ARMD patients report having difficulty driving.[11] Many ARMD patients tend to self-regulate their driving but limiting driving to daylight or familiar roads does not necessarily increase their safety.[11]

The current standards for vision screening for drivers' licenses is varied and outdated in the United States. Each state has different requirements for getting and sometimes maintaining a driver's license in regards to vision. The majority of states require some form of visual field test in addition to the visual acuity screener. The biggest variability between states is in regards to vision screening renewal period. A majority of states require some form of vision test at license renewal but many states do not test vision. As we age our ability to process visual information degrades as well as our general ocular health. We would expect those affected by diseases common to those over 65 such as cataracts, glaucoma and macular degeneration to show an increase rate of accidents in states where vision is not tested at license renewal.

The purpose of this study was to examine the relationship between accident rates in those 65 and older in states with no vision screening requirements and states with vision screening required within a five -year period

CHAPTER 2

METHODS

First, research was gathered about how different aspects of vision impacted driving. Then using department of transportation websites data was collected for 2015 looking for percentage of accident rates when sorted by age. States were grouped together into two categories, states with no vision screening requirement and states with a frequent vision screening requirement.

Participants

The participants for this study were selected based on the criteria of age and having been in a traffic accident in the year 2015. All sexes, genders, and races were included due to inability to sort out that information on the transportation websites. The total number of states used in this study was 13. Six of the thirteen fall into the "non-vision screening group" and the other seven fall into the "within 5 years' vision screening group".

Materials

The materials used for this study were minimal due to the nature of the research. A computer with an internet connection was used to search for state department of transportation data. The database used for all journal articles referenced in this study was

the Ferris State University FLITE library. Articles were sorted by relevance to the topic, peer reviewed status, and date of publication.

Design

The research design of this study was non-experimental correlational research as it studied the relationship between how often vision screenings are performed at the department of motor vehicles and accident rates in those 65 and older. The variables in this study were strictness of vision testing and car accident rates. The criteria for strictness was set based upon frequency of required vision testing. States were labeled either as no test required or test required at least every 5 years for those 65 and older. The independent variable for this research was the licensure renewal period and the dependent variable was accident rates among those 65 and older. Some confounding variables that were not able to be controlled were reasons for each accident, eye health of those in accidents, cognitive health, and general health of those in accidents.

Procedure

A web based search was performed to collect data. Data was collected from twelve different states and the district of Colombia for the years of 2015 and 2016. Only those drivers over the age of 65 were included in this study. State licensure data was collected using the Department of Transportation website for the respective states. Crash data was collected from either Department of Transportation (DOT) websites or the national highway traffic safety administration (NHTSA) (see table 1).

Table 1: States included in study, renewal periods, licensure requirements and accident rates[6]

State	Renewal	Vision requirements	Accident rate >65
Arizona	>65 every 5 years	Unrestricted: 20/40 or better both eyes Restricted: 20/50 or better using one eye VF: monocular of 70 temp and 35 nasal	9.20%
Idaho	>63 every 4 years	Unrestricted: 20/40 or better one eye VF: n/a	10.5%
Iowa	>70 every 2 years	Unrestricted: 20/40 or better in both eyes or one eye Restricted: 20/70 or better VF: binocular 140 or better. 140-100= extra mirrors	10%
Illinois	>75 every 4 years >81 every 2 years	Unrestricted: 20/40 or better in both eyes or one eye Restricted: 20/41 to 20/70 VF: 140 BI or 70 T and 35N	7.9%
Kansas	>65 every 4 years	Unrestricted: 20/ 40 or better in at least one eye Restricted: 20/60 VF: 110 with both eyes and 55 in one	10.27%
Maine	>65 every 4 years	Unrestricted: 20/40 or better with no conditions Restricted: 20/100 in best eye VF: 120 Binocular, 50 left and 50 right	20%
DC	>65 4 years	No less than 20/40 in the best eye OR No less than 20/70 in the best eye and VF of 140	5.1%
Alabama	none	Unrestricted: VA 20/40 Restricted: VA 20/60 VF: 110	5.5%
Connecticut	none	Unrestricted: 20/40 vision VF: 140 binocular	8.85%
Kentucky	none	Unrestricted: 20/60 or better in one eye VF: 25 left and right, 25 up and down	10.3%

Oklahoma	none	Unrestricted: 20/60 or better Restricted: 20/100 VF: 70 degrees or 60 if restricted	9.04%
Pennsylvania	none	Unrestricted:20/40 Restricted: 20/100 VF: 120 degrees	10%
Tennessee	none	Unrestricted: 20/40 or better Restricted: 20/60 or better restricted with side mirrors VF: 150 degrees of field	7.83%

CHAPTER 3

RESULTS

The results of this study were not what was expected for the population chosen. One would expect that, due to the visual challenges those over 65 face, that they would have higher accident rates when a vision screening was not required for driver license renewal. Despite older populations having a greater risk of ocular diseases such as glaucoma, cataracts, and macular degeneration, there was not a statistically significant different in accident rates between the two groups. Results indicate no significant difference between the no vision screening group (*M=10.42, SD=4.62)* and the within 5 years screening group (*M=8.58, SD=1.74), t(11)=0.9147, p=0.380* (see table 2). As demonstrated in many of the previous research articles reviews, the current vision requirements for licensure are not shown to correlate with accident rates in those over 65. But as this study illustrated, even when vision is not tested for, accident rates do not differ in the population with the most visual difficulty. Even though there are many limitations as stated below, this study supports other research demonstrating, that visual field and visual acuity do not correlate to driver safety.

Table 2: Mean, SD, and N for data collected in the study

	No vision screening	Vision screening required
Mean accident rate percentage	10.4243	8.5867
SD for number of states	4.6210	1.7497
N (number of states)	7	6

CHAPTER 4

DISCUSSION

Limitations

This study had a few limitations. One major limitation was lack of consistency between each states Department of Transportation's data collection and analysis. The small sample size used in this study was due to lack of ability to sort by age group for specifically those causing the accidents on the majority of state websites. If there was one database with the same data organization system, it would have been easier to compare more states from each group. Many state websites only listed the percentage of fatal accidents which is not comparable to states who use a percentage of accidents total. Another limitation to this study was the ability to collect up to date data. Due to the timing it takes for states to collect and publish data, this study was only able to use sample data from four years ago. As the population continues to age, it's important to have the most up to date data. One other limitation is the lack of data specific for accident rates where the age of the driver at fault is reported. It is hard to truly determine if those over age 65 cause more accidents or just happen to be in more accidents. Another limitation to this study is that you cannot rule out other cofounding variables such as whether or not drivers with vision difficulties self-limit their driving. Studies have shown

that drivers with vision loss tend to drive less, drive only during the daytime and drive on familiar roads.[12] In order for this study to be more accurate, you'd need to know the true percentage of drivers over 65 that would fail a screening if there was one. Other confounding factors include possible comorbidities affecting driving safety such as systemic health problems, cognitive issues, and other sensory loss.

What driving means to the aging adult

Why is driving so important to the aging population? Driving is associated with independence in the elderly, the ability to come and go as one pleases. Not being able to drive can lead to a life of social isolation for patients who live alone. [4] Loss of the ability to drive has been associated with a high risk of depressive moods and decreased quality of life. [4] It is important to find a more accurate way to assess visual ability as it pertains to driving. The lack of studies that show a correlation specifically between visual acuity and driving means that many seniors are losing their licenses based on a test that does not truly predict their crash risk. When drivers lose their licenses not many have options for other transportation, especially if they live in a rural area. Currently, once you get outside metropolitan areas, there is not many options for those who lose their license to get around.[11]

Further research

After researching many aspects of vision and driving, I believe further research is needed to find a more accurate method of testing driving ability, specifically in those older than 65. If the factors affecting safety are not visual acuity and visual field, then it

is important to know what they are. When controlling for driving time, older people are at a greater risk of accidents, and more importantly older people are more likely to be severely injured in accidents.[2]

One study by Tatham, Boer, Grecitelli, Rosen and Mederios looked at a group of glaucoma patients to see whether there was a correlation to being in a motor vehicle crash and their ability to divide attention using a driving simulator.[9] This driving simulator also varied contrast of peripheral targets to assess the role contrast played. This study also assesses whether visual field was a good indicator for predicting motor vehicle accidents. The study concluded that the current standard of visual field testing was not indicative of motor vehicles crashes in patients with glaucoma.[9] They also showed that a driving simulation is a cost effective and simple way to assess patients for crash risk by testing their ability to divide attention. The most significant difference between no car accidents and car accidents was the low-contrast targets, indicating contrast sensitivity also plays a role in field of vision and driving.[4]

In order to find a safer, more reliable approach to testing vision, states should look into useful field of view testing and driving simulations that assess divided attention. A useful field of view test (UFOV) is performed on a computer and evaluates an individual's processing speed and their ability to divide attention.[4] The tester is forced to identify peripheral targets while focusing on a central task, the test also uses distractors throughout.[13] UFOV relies on higher order processing such as divided attention, selective attention, and visual processing.[2] Studies that looked at the role UFOV could play in assessing driver safety as a function of age showed that is has a key role in testing driving safety.[5] Older drivers with a 40% reduction in UFOV had a 2.2 times increase in risk for

accidents compared to controls.[2] Now in order for this testing to have merit, larger studies need to be performed across many different types of visual impairment, but it does hold some promise.

Another topic with some studies already showing statistical significance when it comes to driving safety and vision is contrast sensitivity. Many of the common conditions that affect older drivers such as cataracts and ARMD cause loss of contrast sensitivity. Studies comparing patients with loss of contrast sensitivity due to cataracts showed that poor contrast sensitivity was correlated with an increased risk of accidents compared to age matched norms.[4] Other studies have shown a decrease risk of accidents in cataract patients after having their cataracts removed. This reduced the risk of accidents up to fifty percent.[4] Currently no states use contrast sensitivity as part of their license requirements.

Conclusion

Studies results are varied but most studies concluded that neither visual field nor visual acuity were good indicators of driver safety. The current standards set for visual function required for getting and renewing a driver's license are out dated and not a reliable indicator of driver safety. In addition, the wide range of variability between states makes it confusing and difficult for drivers to know whether their vision falls within those limits. A common standard amongst all states should be evaluated and that other testing considered as either included at the department of motor vehicles, or patients should be required to have an eye exam with a licensed optometrist or ophthalmologist every set number of years. It seems there is a smarter and safer way to test our older

patient's ability to maintain their driver's license that may better predict crash risk and reduce injury and death.

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