Highway Accident Patterns in Michigan Related to Older Drivers

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Discussed in this paper are age-group comparative research analyses for trunkline highway accidents in the state of Michigan. Statistics are presented on the frequency and severity of highway accidents and the factors responsible for the types of violations cited in these highway accidents are examined.

Differences in the metric used to indicate exposure to accidents have resulted in considerable debate concerning the relative driving safety of older drivers. In this research, age 60 was taken as the threshold for the definition of the older driver because it was shown that in most instances accident overinvolvement begins to occur between ages 60 and 65. As a result of research conducted in Michigan related to the accident patterns of older drivers (1), comparative highway accident data on the state trunkline system based upon several exposure metrics may be developed. Detailed study of these records leads to an identification of several of the factors which differentiate between the accident patterns of younger, middle-aged, and older drivers.

LICENSING TRENDS AND TRAVEL STATISTICS

Licensed data for Michigan indicate that in the period from 1981 through 1986 there were an average of 6.3 million licensed drivers per year in the state. During this period, the total number of licensed drivers increased by only about 1 percent. However, the number of licensed younger drivers, those between age 16 and 24, decreased by 14.6 percent and in 1986 represented about 18.7 percent of the licensed drivers. The number of older drivers, those aged 60 and above, increased by about 14.0 percent over this period and in 1986 represented about 18.1 percent of the licensed drivers in the state (2). These data clearly show that the decrease in younger drivers in the state is being offset by an equivalent increase in older drivers. Perhaps more significant is the fact that the number of licensed drivers of age 70 or more increased by 32.2 percent over this period, and in 1986 this group represented 7.3 percent of the driving population in the state.

Data representing the number of vehicle-miles of travel by drivers of different age groups show that drivers age 60 and over are responsible for about 11.4 percent of the vehicle-miles of travel in this country. Both licensing and travel data are typically utilized as measures of exposure in order to estimate the relative safety of drivers on highways in this country.

Highway Accident Statistics

Depending upon the measures used, older drivers may be considered to be either relatively safe or relatively unsafe drivers. The number of reported interstate and noninterstate multivehicle accidents on the state trunkline system in Michigan during the period from 1983 through 1985, the most recent period for which complete data are available, is shown in Table 1 by age group.

As may be seen, the total number of reported accidents increased over this period by 40.5 percent. Interstate accidents, which represented 13.0 percent of the reported accidents in 1985, increased by 62.9 percent and non-interstate accidents, which represented 87 percent of the reported accidents in 1985, increased by 37.7 percent. The reasons for the disproportionate changes in interstate and noninterstate accidents is thought to represent the effect of improved economic conditions and stable fuel prices, which results in greater vehicle-miles of travel. The relative involvement of each of the age groups in total accidents remained relatively stable over this period.

Comparative Accident Involvement Measures

The proportion of age group involvement in reported accidents in 1983 may also be compared to the proportion of the number of vehicle-miles of travel and the proportion of licensed drivers in each age group as shown in Table 2. If the proportion of vehicle-miles of travel and the proportion of licensed drivers are considered measures of accident exposure, then a group is underrepresented or underinvolved in accidents if the ratio of the proportion of accidents to the respective exposure metric is less than 1.0. If the ratio is greater than 1.0, the group is over-represented or over-involved in accidents. Underinvolvement infers more safety in driving and overinvolvement infers less safety in driving. A ratio of 1.0 indicates the rate of involvement in accidents is equal to the rate of exposure to accidents.

As may be seen in Table 2, the ratio of the percentage of accidents to the percentage of vehicle-miles of travel indicates that younger drivers are involved in accidents at a rate of more than twice their exposure, older drivers are involved in accidents at a rate slightly above their exposure, and middle-aged drivers are involved in considerably fewer accidents than their rate of exposure. When the ratio of the percentage of accidents to the percentage of licensed drivers is used, younger drivers are significantly overinvolved in accidents, older drivers are considerably underinvolved in accidents, and middle-
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variou type of vehicle-miles of travel and the number of licensed drivers are valid exposure metrics that have legitimate applications to various types of travel studies. Since most data indicate that the drivers in each age group do not drive the same amount of mileage or operate under driving conditions with the same degree of difficulty, more credibility in accident analysis is usually attached to the first exposure metric based on vehicle-miles of travel. If this interpretation is used here, it is also apparent from these data that driver safety increases with increasing age between younger drivers and middle-aged drivers but also decreases with increasing age between middle-aged drivers and older drivers. The accident ratio for older drivers is 51.3 percent higher than that for middle-aged drivers. For drivers of age 70 and above, Michigan data indicate that the rate of accident involvement approaches that of the younger driver.

The rate of accident occurrence is often stated in terms of the number of accidents per licensed driver or the number of accidents per vehicle-mile of travel. These data have been analyzed for the period from 1983 to 1985 on the state trunkline system by the average annual accident rates are shown in Table 3. As may be seen from these data, the average accident rate for all drivers on the state trunkline system was 11.8 accidents per thousand licensed drivers and 1.15 accidents per million vehicle-miles of travel. The accident rate of younger drivers is significantly higher than the average for both exposure metrics; whereas, the accident rates for middle-aged and older drivers are slightly less than the average for both exposure metrics. Again, the accident rate for older drivers is higher than that for middle-aged drivers by 23.9 percent based upon the vehicle-miles of travel exposure metric.

As a result of this research, a measure of the exposure of drivers of different ages to accidents was derived from the records for trunkline system accidents in the state. This measure of exposure has been discussed in the literature. It is based upon the relative frequency of driver involvement in multivehicle accidents in which the driver was not cited on the accident record for committing a hazardous action contributing to the accident, that is, Driver 2. This is termed the “innocent victim” concept of exposure to accidents. The Driver 2 percentage in all multivehicle accidents in Michigan in 1983 for drivers age 60 and over was found to be 10.2 percent. A relative accident involvement ratio was derived for use in this research. This ratio was defined as the ratio of the relative frequency of multivehicle accident involvement in which a driver was cited for committing a hazardous action contributing to the accident, Driver 1, to the relative frequency of multivehicle accident involvement in which the driver was not cited for a hazardous action contributing to the accident, Driver 2. If the ratio is less than 1.0, accident involvement is less than accident exposure, or an underinvolvement in accidents, which is interpreted in this research as indicating less driver safety. If the ratio is greater than 1.0, accident involvement is greater than accident exposure, or an overinvolvement in accidents, which is interpreted in this research as indicating less driver safety.

This measure of relative accident involvement is similar to that developed by Cerrelli (6,7) in which drivers were divided into those responsible and not responsible for multivehicle accidents to develop a relative exposure index, a liability index, and a hazard index for drivers of various age groups. The principal difference between Cerrelli’s work and this research is that an examination of many different types of multiple vehicle accidents was undertaken to discover, for example, the relative accident involvement ratio on interstate and non-interstate highways, both at interchanges and intersections.

Most of the work of others, for example, Carlson (8), Haight

### Table 1: Reported Trunkline Multivehicle Accidents in Michigan, 1983 and 1985

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger</td>
<td>2,073</td>
<td>3,514</td>
<td>20,080</td>
<td>28,315</td>
<td>22,153</td>
<td>31,829</td>
</tr>
<tr>
<td>Middle-aged</td>
<td>4,366</td>
<td>7,132</td>
<td>28,210</td>
<td>38,748</td>
<td>32,576</td>
<td>45,880</td>
</tr>
<tr>
<td>Older</td>
<td>580</td>
<td>787</td>
<td>7,082</td>
<td>9,174</td>
<td>7,662</td>
<td>9,961</td>
</tr>
<tr>
<td>Total</td>
<td>7,019</td>
<td>11,433</td>
<td>55,372</td>
<td>76,237</td>
<td>62,391</td>
<td>87,670</td>
</tr>
</tbody>
</table>

### Table 2: Comparison of Proportion of Age Group Representation in Multivehicle Accidents, Vehicle-Miles of Travel, and Licensed Drivers for All Reported Trunkline Accidents in Michigan, 1983

<table>
<thead>
<tr>
<th>Driver Category</th>
<th>Percentage of Accidents</th>
<th>Ratio of Percentage of Accidents to Percentage of VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger</td>
<td>35.5</td>
<td>2.22</td>
</tr>
<tr>
<td>Middle-aged</td>
<td>52.2</td>
<td>0.72</td>
</tr>
<tr>
<td>Older</td>
<td>12.3</td>
<td>1.09</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>1.75</td>
</tr>
</tbody>
</table>
TABLE 3 ANNUAL AVERAGE TRUNKLINE MULTIVEHICLE ACCIDENTS, LICENSED DRIVERS, VEHICLE-MILES OF TRAVEL, AND ACCIDENT RATES FOR THE MICHIGAN TRUNKLINE SYSTEM, 1983 THROUGH 1985 (2, 4)

<table>
<thead>
<tr>
<th>Driver Category</th>
<th>Total Accidents</th>
<th>Licenses (Thousand)</th>
<th>VMT (Million)</th>
<th>Licenses (Thousand)</th>
<th>VMT (Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger</td>
<td>26,570</td>
<td>1,310</td>
<td>12,125</td>
<td>20.3</td>
<td>2.19</td>
</tr>
<tr>
<td>Middle-aged</td>
<td>38,443</td>
<td>3,890</td>
<td>43,841</td>
<td>9.9</td>
<td>0.88</td>
</tr>
<tr>
<td>Older</td>
<td>8,667</td>
<td>1,026</td>
<td>7,972</td>
<td>8.4</td>
<td>1.09</td>
</tr>
<tr>
<td>Total</td>
<td>73,680</td>
<td>6,226</td>
<td>63,938</td>
<td>11.8</td>
<td>1.15</td>
</tr>
</tbody>
</table>

(9, 10), Koornstra (11), and Thorpe (12), sought to formulate measures of induced exposure from accident records related to both single and multivehicle accidents and, in some cases, from licensed drivers [for example, Wasielewski and Evans (13)]. This research did not seek to derive exposure from these accident records but defined exposure based upon the innocent victim in a multiple vehicle accident. This approach is similar to that used by Carr (14) and Hall (15) in the assigned responsibility model. A comparison of the results of the research reported herein with that of others was reported earlier (4).

Using this relative accident involvement ratio, it can be shown that older drivers are more likely to be involved in highway accidents than other drivers when the innocent victim concept is used as a measure of exposure to highway accidents. Table 4 shows the designation of Driver 1 and Driver 2 for state trunkline multivehicle accidents for the period from 1983 through 1985. These data indicate that in about 221,000 multivehicle accidents over this period, older drivers were cited as the driver at fault in 11.8 percent of the accidents and were considered the innocent victim in 9.9 percent of the accidents. Therefore, older drivers are over-involved in accidents with a relative accident involvement ratio of 1.19. This over-involvement ratio is similar to that of younger drivers who have a relative accident involvement ratio of 1.21, but it is 38.4 percent higher than middle-aged drivers who have a relative accident involvement ratio of 0.86.

TYPES OF ACCIDENTS

Because of the significantly higher occurrence of non-interstate accidents, analyses were performed on the accident data to try to gain some knowledge of the accident patterns of older drivers. When the accident data are tabulated into single and multivehicle non-interstate trunkline accidents, as shown in Table 5, older drivers tend to be involved in multivehicle accidents to a greater extent than other drivers. That is, given that an older driver is involved in an accident, there is an 83.1 percent chance that it is a multi-vehicle accident; whereas, for all drivers there is only a 75.4 percent chance that it is a multivehicle accident. These data suggest that there is a greater chance for older drivers to involve other drivers in accidents than there is for the driving population at large.

The noninterstate multivehicle accidents were then broadly categorized into rear-end, head-on, angle, and side-swipe type accidents. These data show that older drivers are slightly more susceptible to head-on accidents than either younger or middle-aged drivers and significantly more prone to angle type accidents than either of the other driver groups.

Older drivers have a greater chance of being cited for a violation when they are at fault in an accident than do other drivers. Data show that in 16 percent of the head-on accidents in which younger drivers were at fault and 21 percent of the accidents in which middle-aged drivers were at fault, no violation of traffic laws was cited in the accident record as contributing to the accident. However, only in about 12 percent of the accidents in which older drivers were at fault was no violation cited. Typically, older drivers are cited for failure to yield the right-of-way and illegal turns to a greater extent than other drivers for head-on accidents. In rear-end accidents, older drivers are more frequently cited for failure to yield the right-of-way, illegal turns, and improper lane usage than other drivers. Failure to yield the right-of-way is the major violation for all drivers in angle accidents at intersections, but the incidence of this violation is proportionately higher for older drivers.

TABLE 4 RELATIVE ACCIDENT INVOLVEMENT RATIO FOR MULTIVEHICLE ACCIDENTS ON THE STATE TRUNKLINE SYSTEM, 1983 THROUGH 1985 (4)

<table>
<thead>
<tr>
<th>Driver Category</th>
<th>Driver 1</th>
<th>Driver 2</th>
<th>Relative Accident Involvement Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
</tr>
<tr>
<td>Younger</td>
<td>79,709</td>
<td>36.0</td>
<td>68,329</td>
</tr>
<tr>
<td>Middle-aged</td>
<td>115,529</td>
<td>52.2</td>
<td>138,746</td>
</tr>
<tr>
<td>Older</td>
<td>26,001</td>
<td>11.8</td>
<td>22,674</td>
</tr>
<tr>
<td>All</td>
<td>221,039</td>
<td>100.0</td>
<td>229,749</td>
</tr>
</tbody>
</table>
FACTORS RESPONSIBLE FOR ACCIDENTS

The accident reporting form completed by the investigating officer at the scene of an accident is converted into a computerized record that lists items which may be indicated as contributing circumstances to the accident. The contributing circumstances for non-interstate trunkline accidents show that for each age group both skidding and driving under the influence are the major contributing circumstances for such accidents. There is little difference in the percentage of accidents attributed to skidding among the age groups, each age group having slightly over 30 percent of its accidents due to this contributing circumstance. The incidence of driving under the influence as a factor in about 32 percent of the accidents for drivers in the age group from 25 to 59 is not unexpected. However, the fact that about the same percentage of accidents, 22 percent, have driving under the influence as a factor for both the younger and older age groups was somewhat surprising given the frequency of younger driver involvement in alcohol-related accidents. It was expected that older driver involvement in such accidents would be considerably less than younger drivers. It is thought that the relatively high proportion of leisure time available to older drivers may contribute to this phenomenon.

Perhaps more significant is the relative percentage of accidents due to illness, fatigue, or inattention and due to obscured vision for older drivers relative to other drivers. These two contributing circumstances are more significant for older drivers than they are for the other driver groups. This tends to confirm suggestions that physical limitations or mental distractions play a significant role in contributing to multi-vehicle accidents involving older drivers. The type of visual obstruction is also noted on the accident record. These data show that slightly more than 50 percent of the visual obstructions for each age group are physical obstructions outside the vehicle. Each of the other types of visual obstructions, except glare, seem to follow expected patterns. In the case of glare, the older driver is affected by this factor to a greater extent than other drivers. This likely follows from the fact that there is a significant decrease in visual acuity for older drivers.

ACCIDENT SEVERITY

An examination of non-interstate accidents for severity was also undertaken. Accident severity is indicated on the accident record as a fatality, incapacitating injury, non-incapacitating injury, possible injury, or no injury. The data were analyzed for all such accidents during the period from 1983 through 1985 and the results show that 28 percent of the fatalities are younger drivers, 50 percent are middle-aged drivers, and 22 percent are older drivers. However, there is a higher incidence of a fatality occurring than each of the other types of accident severities for an older driver involved in an accident.

The fatality rate for older drivers is the highest of any of the driver categories by either exposure metric. It is 33.7 percent higher than the average rate for all drivers using thousands of licensed drivers as the exposure metric, and it is 81.3 percent higher than the average rate for all drivers using the millions of vehicle-miles of travel metric. These data indicate that there is a greater chance for an older driver to be a fatality in an accident than there is for other drivers.

SUMMARY

This paper has shown that the accident records of older drivers are not nearly as good as those of middle-aged drivers. In some cases, the accident records of older drivers are similar to those of young drivers. A new exposure metric based upon the "innocent victim" concept was introduced and the relative safety of various driver groups computed on the basis of this exposure method compares favorably to accident rates based upon the vehicle-miles of travel exposure measures.

Trends in the licensing of drivers in the state indicate that younger drivers are being replaced by older drivers in the population in a virtually one-to-one ratio. Accident data in Michigan indicate that older drivers are more likely to be involved in a multi-vehicle accident than other drivers and that older drivers have a greater proneness for head-on and angle-type accidents on non-interstate highways than other drivers. Older drivers are cited for violations related to failing to yield the right-of-way, illegal turns, and improper lane use to a greater extent in the accidents in which they are involved than are other drivers. Glare seems to affect older drivers more than other drivers, which may be due to diminished visual acuity. The fatality rate of older drivers is considerably higher than that of all drivers.

It is expected that the findings summarized above are applicable to the study of the driving safety of older drivers throughout the country.

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REFERENCES


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