Risk drivers pose to themselves and other drivers by violating traffic rules

Praveena Penmetsa and Srinivas S. Pulugurtha

Department of Civil and Environmental Engineering, The University of North Carolina at Charlotte, Charlotte, North Carolina

ABSTRACT

Objective: Violation of traffic rules is a major contributing factor in both crashes and fatalities in the United States. This study aims at quantifying risk that drivers pose to themselves and other drivers by violating traffic rules.

Method: Crash data from 2010 to 2013 were gathered for the state of North Carolina. Descriptive analysis was carried out to identify frequent traffic violations and who were committing the traffic violations that resulted in crashes. A multinomial logit model was then developed to examine the relation between different traffic violations and driver injury severity. Additionally, odds ratios were estimated to identify the likelihood (probability) of severe or moderate injury to the driver and other drivers due to a driver violating a traffic rule that led to a crash.

Results: Exceeding the speed limit is more likely to result in severe injury compared to disregarding traffic signals. However, going the wrong way is more likely to result in severe injury to other drivers when compared to any other traffic violation. Driving under the influence of alcohol is twice more likely to result in severe injury than driving under the influence of drugs. These 2 traffic violations by a driver are almost equally likely to result in severe injury to other drivers.

Conclusions: Drivers often perceive that violating traffic rules will not result in a crash or severe injury. However, the results from this study show that a majority of the traffic violations lead to severe injury to the violator as well as to other drivers. The findings from this study serve as documented evidence to educate drivers about the risk they pose to themselves and to other drivers by violating traffic rules and encourage the adaptation of safe driving behavior in order to contribute toward reaching the “zero traffic deaths” vision. They also help make policy changes pertaining to penalty points and fines for violating a traffic rule.

Introduction

Though the fatality rate per vehicle miles traveled (VMT) has reduced over the years, 32,719 people died in motor vehicle crashes in the United States during 2013. North Carolina has reported 1,299 traffic fatalities and more than 100,000 injuries crashes in the United States during 2013. North Carolina has reduced over the years, 32,719 people died in motor vehicle crashes in the United States. This study aims at quantifying risk that drivers pose to themselves and other drivers by violating traffic rules.

Crash reports still indicate that violation of these traffic rules is a major contributing factor in both crashes and fatalities in the United States. Crashes involving speeding and driving under the influence of alcohol together accounted for 58% of the total fatalities in the United States (National Center for Statistics and Analysis 2015). During 1999 and 2000, around 1,990 and 1,294 people were killed at intersections for not obeying traffic signals and failing to yield the right of way, respectively, in the United States (Campbell et al. 2004). According to the Insurance Institute for Highway Safety, red light violations are the leading cause of urban crashes in the United States.

Numerous studies were carried out in the past on examining the role of driver characteristics in violating traffic rules or at specific locations. Moyano-Diaz (1997) measured the attitude of people toward traffic violations in Santiago. The study concluded that men are more risk takers than women and the same was stated by Yagil (1998) and Gonzalez-Iglesias et al. (2012). Shinar et al. (2001) stated that seat belt usage is positively correlated with age and level of education. Fosgerau (2005) found a significant correlation between driving speed and driver age as well as driving speed and driver income. Machin and Sankey (2008) indicated that excitement, altruism, risk-taking attitude, and their own likelihood of being involved in a crash accounted for 39% of young drivers’ speeding. Braithman et al. (2007) identified that failing to yield the right of way increases with age. Factor et al. (2008) concluded that social habits and technological advancements play a major role in varied crash risk. Yamamura (2008) concluded that informal restrictions are more beneficial than formal legal restrictions in reducing dangerous driving behaviors. Zhang et al. (2013) examined specific
risk factors that are associated with traffic violations and crash severity.

Abdel-Aty (2003) used ordered probit models to analyze driver injury severity at different locations and concluded that drivers’ traffic violations were significant in causing severe injuries at signalized intersections. Waller et al. (1986), Stoduto et al. (1993), Li et al. (1997), Cunningham et al. (2002), and Drummer et al. (2004) studied the effect of alcohol on driver injury severity in crashes. Retting et al. (2003) analyzed motor vehicle crashes at 2-way stop-controlled intersections. Stop sign violations accounted for 70% of the total crashes considered in their study. Drivers less than 18 years old and older than 65 years were found at fault in crashes that occurred due to violating stop signs. Pai and Saleh (2008) examined motorcyclists’ injury severity at intersections using ordered probit models and concluded that motorcyclists are seriously injured when right-turning vehicles fail to yield the right of way. Zhou et al. (2015) observed that approximately 80% of wrong-way driving crashes occur in urban areas and nearly 70% of wrong-way driving vehicles are passenger cars. More than 50% of wrong-way drivers were found to be under the influence of alcohol or drugs. Shankar and Mannering (1996), Carson and Mannering (2001), Khorashadi et al. (2005), Islam and Mannering (2006), Savolainen and Ghosh (2008), Malyskhina and Mannering (2008), and Geddipally et al. (2011) used multinomial logit models for assessing driver or crash severity but did not focus specifically on traffic violations. Ayuso et al. (2010) examined the influence of traffic violations on the likelihood of resulting in a serious or fatal crash using data for Spain. Some of their conclusions sound contradictory and are not applicable to all countries or locations. Additionally, traffic violations such as right turn on red, improper lane change, improper lane use, operating defective equipment, driving under the influence of alcohol, and driving under the influence of drugs were not considered in their study.

Overall, driver injury severity has been extensively studied for various crash types and under different situations. Research efforts such as Goldenbeld et al. (2013) showed that an increase in traffic offense frequency (number of violations) coincides with a stronger increase in relative crash involvement. However, literature documents no research on the extent to which drivers are injured in crashes due to different traffic violations. Educating and creating awareness about potential crash risk drivers pose to themselves due to violating traffic rules may lead to a reduction in the number of crashes and contribute toward reducing the “zero traffic deaths” vision. Unarguably, traffic violators pose a risk not only to themselves but also to other road users. These other road users may include drivers of other vehicles who did not violate any traffic rules, passengers in the vehicles involved in the crash, pedestrians, or bicyclists. The average vehicle occupancy is less than 1.5 and more than two thirds of the vehicles on major roads in the study area are single-occupant vehicles; driver only (PBSI 2004). Furthermore, several crash records have missing occupant (passenger) details (injury severity type, gender, age, seat position, etc.). Considering multiple vehicle crashes with more than one driver violating traffic rules may add complexity and have a profound effect on the estimated risk. Accounting for these limitations, only drivers of other vehicles who did not commit any traffic violations were considered in this research. Overall, this study aims to quantify (1) the risk drivers pose to themselves (in terms of driver injury severity) by violating traffic rules and (2) the risk drivers (traffic violators) pose to other drivers who did not violate any traffic rules.

Method

Crash details are typically collected and reported by the law enforcement officers in the field. The reports are then entered into a crash database by the responsible state or local transportation agency staff. Any validation or reconstruction of a crash is performed by law enforcement and state or local agencies. The Highway Safety and Information System (HSIS) staff gathers all relevant data from selected state and local transportation agencies to develop and share the comprehensive database.

The crash data used in this research were gathered for the state of North Carolina from 2010 through 2013 from HSIS. The crash information is provided in 4 different files: accident, roadway, vehicle, and occupant files. These files are connected using the unique identification number provided for each crash.

Council and Nujetty (2014) summarized the variables and related details pertaining to information available in the HSIS database. The contributing factor, driver age, driver gender, injury severity type, lighting condition, and number of vehicles involved in each crash were only considered in this research. Except for the aforementioned variables, all other variables were deleted from the database. Crashes that have missing values or information were also removed from the database.

There were a total of 643,051 crash records for the study period. The data were processed so that each row represents a vehicle involved in the crash. Data obtained showed that 1,063,093 vehicles were involved in these crashes. Crashes in which more than 3 vehicles, pedestrians, or bicyclists were involved were not considered in the analysis (their contribution was less than 2% of the total crashes). The vehicle file provides the contributing factor for each vehicle involved in the crash. Consider an example in which a left-turning vehicle at an intersection did not yield to the through traffic and ended up in a collision (crash) with a through vehicle. In this case, the left-turning vehicle’s contributing factor is recorded as “failing to yield the right of way” and the other vehicle’s contributing factor is recorded as “no contributing factor.” In this case, the driver in the left-turning vehicle violated the traffic rule and put him- or herself as well as the other driver and passengers at risk. When the through vehicle exceeded the authorized speed limit, the other vehicle’s contributing factor was recorded as “exceeded authorized speed limit” and the violation of the left-turning vehicle was still the same. The risk to the drivers and passengers of both the vehicles in the latter case might be affected due to the additional violation of the through vehicle. Such multiple violations in a crash are not considered in the analysis to accurately assess the risk of a traffic violation to the driver and other drivers. For the 4-year database, around 25,000 crashes occurred in which more than one driver involved in the crash committed some type of traffic violation. These were removed from the database and ignored for further analysis.

A driver may have violated multiple traffic rules (e.g., exceeded the speed limit and disregarded road signs) that may
have led to a crash. If all such combinations are considered, there would be more than $2^{22}$ combinations. Therefore, only the primary contributing factor by the driver that led to a crash was considered for analysis. This would minimize any ambiguity that could arise due to the effect of different driver contributing factors in a crash. Records were also removed if the traffic violation was not in the list shown in the first column of Table 1. Overall, records of the drivers who violated traffic rules listed in Table 1 were only extracted and considered for analysis. This final data set to assess the risk drivers pose to themselves due to violation of a traffic rule consisted of 227,504 records (information pertaining to 227,504 drivers who violated traffic rules).

To examine the risk drivers (traffic violators) pose to other drivers (who did not violate any traffic rule), only 2-vehicle crashes were considered (more than 2-vehicle crashes contribute to less than 5% of the total crashes). A total of 350,180 2-vehicle crashes occurred from 2010 to 2013 in North Carolina. In 21,143 crashes, more than one driver violated some kind of traffic rule. These were removed from the database. Therefore, during the study period, 329,037 2-vehicle crashes occurred in which the driver of only one vehicle committed some kind of traffic rule violation. This implies that at least 329,037 drivers were involved in crashes due to another driver’s error. These drivers are exposed to some type of injury or risk due to drivers violating traffic rules. Of the 329,037 crashes (records of drivers violating a traffic rule in 2-vehicle crashes), records pertaining to traffic violations not listed in Table 1 were removed from the data set. The final data set to assess risk to other drivers due to violation of a traffic rule consisted of 139,505 records.

Figure A–1 (see online supplement) summarizes the data processing and development of the final database for the analysis. The dependent variable in this study is driver injury severity. HSIS defines 5 levels of injury severity: fatality, incapacitating injury, nonincapacitating injury, possible injury, and property damage only (PDO). Incapacitating injury means that the person was impaired or disabled because of the crash. Nonincapacitating injury is any injury other than a fatal injury or an incapacitating injury that is evident to observers at the scene of the crash. Possible injury requires very minimal medical assistance, and no injury is observed in case of PDO crash. In this study, the severity of driver injury was redefined into 3 categories. Fatal and incapacitating injury levels were combined and considered the severe injury category, and nonincapacitating injury and possible injury levels were combined and considered the moderate injury category. PDO is considered the no injury category.

Multinomial logit models were developed to examine the effect of different traffic violations (independent variable) on driver injury severity (dependent variable). Unarguably, factors such as age and gender of the driver, lighting condition, and other network characteristics have an effect on the number of crashes (possibly, injury severity). However, the intent is not to have such independent variables control the role of traffic violation on risk. Furthermore, penalty points and fine amount do not generally vary with these independent variables. Therefore, these variables were not considered as independent variables in this study.

Two different sets of multinomial logit models were developed to examine (1) the risk drivers pose to themselves by violating traffic rules and (2) the risk drivers violating traffic rules pose to other drivers. The maximum likelihood estimate was used in estimating the coefficients of the variables. The coefficients of the model explain whether the independent variable increases or decreases the probability of the dependent event. To explain the extent of the effect of the independent variables on occurrence of the dependent variable, the odds ratio concept was used. The odds ratios also indicate the probability value. Therefore, only the estimated odds ratios and confidence limits from the developed models are presented in this article. Ben-Akiva and Lerman (1985) presented an in-depth discussion and details pertaining to the development of multinomial logit models and the application of the odds ratio concept.

In logistic regression models, the reference variable should be defined so that the odds can be estimated. Disregarded traffic
signal is considered as the reference for the independent variable; that is, traffic violations. The 2 different cases for which models were developed are as follows:

1. Risk drivers pose to themselves by violating traffic rules when compared to risk drivers pose to themselves by disregarding traffic signals.

2. Risk drivers violating traffic rules pose to other drivers when compared to risk drivers disregarding a traffic signal pose to other drivers.

In all of the models developed, the dependent reference variable is PDO.

Overall, 227,504 records from single-, 2- and 3-vehicle crashes were used to develop the first set of models (risk to themselves; Table 2), and 139,505 records from 2-vehicle crashes were used to develop the second set of models (risk to other drivers; Table 3).

**Results**

Table 2 shows the frequency of selected traffic violations and the percentage distribution of injuries among those violations. The results presented in Table 2 were developed before preparing the data for modeling and analysis. About 51% of the total drivers involved in crashes committed some kind of traffic violation, whereas ~74% of the severe driver injuries occurred due to some kind of traffic violation during the study period. Driving under the influence of alcohol and going the wrong way each contributed ~10% of severe driver injuries from 2010 to 2013. The frequency of driving under the influence of alcohol and going the wrong way is less compared to their contribution to severe driver injuries. Exceeding the authorized speed limit and exceeding the safe speed limit for conditions each contributed ~8% of the total severe driver injuries. Drivers less frequently exceed authorized speed limit when compared to exceeding the safe speed limit for conditions. Among the considered traffic violations, failing to yield the right of way followed by exceeding the safe speed limit for conditions contributed most toward moderate severe driver injuries and PDO crashes. Failing to yield the right of way also contributed considerably toward severe driver injuries. Operating a vehicle erratically or aggressively also had a significant contribution toward severe driver injuries. The percentage of drivers involved in crashes due to improper lane changes is higher than the percentage of drivers involved in crashes due to disregarding traffic signals. However, the contribution of disregarding traffic signals to severe driver injuries is slightly greater than that for improper lane change. Disregarding a stop sign contributed to around 2% of severe driver injuries. The individual contribution of traffic violations such as disregarded a yield sign, right turn on red, passed on a hill, passed on a curve, and improper or no signal to total crashes during the study period was less than 0.1%.

Several factors could encourage drivers to violate traffic rules. Figure 1 exhibits a comparison of the percentage of crashes due to and not due to traffic violations under different lighting conditions and by gender. During daylight, the percentage of crashes due to violation of traffic rules is very high when compared to the percentage of crashes due to no traffic violation. Figure 1 implies that drivers are more likely to not comply with traffic rules when they have good visibility of the roadway. The difference between the percentage of crashes due to and not due to traffic violations is lower during dawn and dark, unlighted roadway conditions. Male drivers are more likely to violate traffic rules and be involved in a crash compared to female drivers; similar to observations made by Moyano-Diaz (1997), Yagil (1998), and Gonzalez-Iglesias et al. (2012). This shows that female drivers are more likely to follow traffic rules compared to male drivers. In simple terms, male drivers are relatively more aggressive and risk takers.

| Traffic violation                          | Severe injury | Moderate injury |
|--------------------------------------------|---------------|----------------|
| Disregarded a yield sign                   | 1.061*        | 0.600          |
| Disregarded a stop sign                    | 5.589         | 1.403          |
| Disregarded other traffic signs            | 2.194         | 0.887*         |
| Disregarded road markings                  | 3.343         | 0.997*         |
| Exceeded the authorized speed limit for conditions | 39.42 | 2.974          |
| Passed on a hill                           | 3.175         | 1.099          |
| Improper turning                           | 0.391         | 0.415          |
| Right turn on red                          | 1.002*        | 0.192          |
| Going the wrong way                        | 13.740        | 1.709          |
| Improper lane change                       | 0.461         | 0.200          |
| Improper lane use                          | 2.222         | 0.715          |
| Passed on a curve                          | 3.952*        | 0.638*         |
| Other improper passing                     | 1.677         | 0.378          |
| Failing to yield the right of way          | 0.897*        | 0.631          |
| Improper or no signal                      | <0.001*       | 0.454          |
| Followed a vehicle closely                 | 0.162         | 0.248          |
| Operated a vehicle erratically or aggressively | 12.210 | 2.159          |
| Operated defective equipment               | 1.641         | 0.679          |
| Alcohol                                    | 14.850        | 1.948          |
| Drugs                                      | 7.152         | 2.485          |
| **Moderate injury**                        |               |                |
| Disregarding a stop sign                   | 5.158         | 1.310          |
| Disregarding other traffic signs           | 2.188         | 1.503          |
| Disregarding road markings                 | 3.183         | 5.118          |
| Exceeded the authorized speed limit for conditions | 39.42 | 51.080         |
| Passed on a hill                           | 3.175         | 1.099          |
| Improper turning                           | 0.391         | 0.415          |
| Right turn on red                          | 1.002*        | 0.192          |
| Going the wrong way                        | 13.740        | 1.709          |
| Improper lane change                       | 0.461         | 0.200          |
| Improper lane use                          | 2.222         | 0.715          |
| Passed on a curve                          | 3.952*        | 0.638*         |
| Other improper passing                     | 1.677         | 0.378          |
| Failing to yield the right of way          | 0.897*        | 0.631          |
| Improper or no signal                      | <0.001*       | 0.454          |
| Followed a vehicle closely                 | 0.162         | 0.248          |
| Operated a vehicle erratically or aggressively | 12.210 | 2.159          |
| Operated defective equipment               | 1.641         | 0.679          |
| Alcohol                                    | 14.850        | 1.948          |
| Drugs                                      | 7.152         | 2.485          |

*Indicates not significant at a 95% confidence level. Disregarded traffic signals is the base for independent variable.
Table 3. Risk drivers pose to other drivers by violating traffic rules.

| Traffic violation                        | Severe injury | Moderate injury |
|------------------------------------------|---------------|-----------------|
| Disregarded a yield sign                | 0.696*        | —               |
| Disregarded a stop sign                 | 3.282         | 2.320           | 4.643           |
| Disregarded other traffic signs         | 0.773*        | —               |
| Disregarded road markings               | 0.554*        | —               |
| Exceeded the authorized speed limit     | 6.409         | 4.104           | 10.010          |
| Exceeded the safe speed limit for conditions | 1.008*      | —               |
| Improper turning                        | 0.358         | 0.230           | 0.557           |
| Right turn on red                       | 0.273*        | —               |
| Going the wrong way                     | 7.114         | 5.476           | 9.241           |
| Improper lane change                    | 0.132         | 0.081           | 0.217           |
| Improper lane use                       | 0.722*        | —               |
| Passed on a hill                        | <0.001*       | —               |
| Passed on a curve                       | <0.001*       | —               |
| Other improper passing                  | 0.770*        | —               |
| Failing to yield the right of way       | 0.918*        | —               |
| Improper or no signal                   | <0.001*       | —               |
| Followed a vehicle closely              | 0.018         | 0.044           | 0.268           |
| Operated a vehicle erratically or aggressively | 3.490      | 2.463           | 4.946           |
| Operated defective equipment            | 0.573*        | —               |
| Alcohol                                 | 4.557         | 3.252           | 6.386           |
| Drugs                                   | 5.306         | 2.843           | 9.906           |

| Odds ratio | 95% Wald confidence limits | Odds ratio | 95% Wald confidence limits |
|------------|----------------------------|------------|----------------------------|
| 0.564      | 0.464                      | 0.686      |
| 1.403      | 1.296                      | 1.518      |
| 0.801      | 0.684                      | 0.939      |
| 0.357      | 0.297                      | 0.428      |
| 1.224      | 1.053                      | 1.423      |
| 0.601      | 0.558                      | 0.648      |
| 0.461      | 0.433                      | 0.491      |
| 0.185      | 0.133                      | 0.259      |
| 1.0440     | —                          | —          |
| 0.189      | 0.078                      | 0.202      |
| 0.280      | 0.222                      | 0.338      |
| 0.293      | 0.087                      | 0.992      |
| 0.619*     | —                          | —          |
| 0.305      | 0.269                      | 0.346      |
| 0.707      | 0.678                      | 0.737      |
| 0.223      | 0.096                      | 0.521      |
| 0.417      | 0.386                      | 0.450      |
| 0.815      | 0.742                      | 0.894      |
| 0.314      | 0.275                      | 0.359      |
| 1.127      | 1.030                      | 1.234      |
| 1.210*     | —                          | —          |

*Indicates not significant at a 95% confidence level. Disregarded traffic signals is the base for independent variable.

Figure 2 shows the percentage of drivers violating traffic rules by age group. From Figure 2, the percentage of drivers violating traffic rules within an age group reduced with an increase in the age of drivers up to some extent and then decreased again. Drivers less than 26 years of age had a huge difference in the percentage (% drivers violating traffic rules minus % drivers involved in crashes without violating any traffic rule). However, this difference is lowest for middle-aged drivers and increased for drivers older than 65 years, who often commit violations due to poor vision (Kline et al. 1992) and misjudgment of gaps.

Drivers younger than 18 years have a high percentage of traffic violations, implying that young drivers take more risks and that their perception of risk is different than that of adult and older drivers.

**Risk of violating traffic rules to themselves**

Table 2 depicts different traffic violations and their likelihood of resulting in severe injury and moderate injury to the driver compared to disregarding traffic signal. In Table 2, 95% Wald confidence limits are provided for the odds ratios. These values explain the range of odds ratio value at a 95% confidence level.

---

**Figure 1.** Percentage of crashes by light condition and gender.

**Figure 2.** Percentage of crashes by driver age group.
If a driver disregarded a yield sign, he or she was equally likely to succumb to severe injury as if he or she disregarded a traffic signal. Disregarding a yield sign is less likely to result in moderate driver injury compared to driver injury in disregarding traffic signals. Disregarding a stop sign is around 6 times more likely to result in severe driver injury and 1.4 times more likely to result in moderate driver injury. Disregarding other traffic signs is 2 times more likely to result in severe driver injury and less likely to result in moderate driver injury. However, the probability estimate for moderate driver injury is not statistically significant in the case of disregarding other traffic signs and disregarding road markings. Exceeding the authorized speed limit is almost 40 times more likely to result in severe driver injury compared to disregarding traffic signals and is 3 times more likely to result in moderate driver injury. Exceeding the safe speed limit for conditions is equally likely as disregarding traffic signals to result in moderate driver injury and 3 times more likely to result in severe driver injury. Improper turning is less likely to result in severe and moderate driver injuries compared to disregarding traffic signals. Right turn on red is equally likely as disregarding traffic signals to result in severe driver injury but is not significant at a 95% confidence level. Among all of the traffic violations, right turn on red is least likely to result in moderate driver injury. This implies that most right turn on red crashes result in PDO. Going the wrong way is the second highest traffic violation in terms of the probability of resulting in severe driver injury. Improper lane change is more likely to result in PDO, and improper lane use is more likely to result in severe driver injury and less likely to result in moderate driver injury. Driving under the influence of alcohol or drugs, operating defective equipment, aggressive driving, passing on a curve, improper passing, improper lane use, and going the wrong way are more likely to result in severe driver injury. Improper turning, improper lane change, and following a vehicle closely are less likely to result in severe driver injury compared to disregarding traffic signals. Failing to yield the right of way, passing on a hill, and improper or no signal are not significant at a 95% confidence level and are less likely to result in severe driver injury. All other traffic violations except operating a vehicle aggressively, driving under the influence of alcohol or drugs, going the wrong way, and disregarding a stop sign are less likely to result in moderate driver injury. Overall, 16 out of 21 considered traffic violations are more likely to result in severe driver injury to the driver compared to disregarding a traffic signal and 7 out of 21 considered traffic violations are more likely to result in moderate driver injury to the driver compared to disregarding a traffic signal.

Risk of violating traffic rules to other drivers

Traffic violators not only put themselves at risk but also put other drivers at risk. Therefore, this part of the study focused on risk drivers violating traffic rules pose to other drivers. Table 3 summarizes the risk to other drivers due to a driver violating a traffic rule. Odds ratios as well as 95% Wald confidence limits for odds ratios are shown in the table.

The risk drivers pose to themselves is higher than the risk drivers violating traffic rules pose to other drivers. Exceeding the authorized speed limit poses the highest risk to other drivers. Going the wrong way is more likely to put other drivers at risk among all traffic violations. Driving under the influence of alcohol or drugs is almost 5 times more likely to put other drivers at higher risk (severe injury). Disregarded a yield sign, disregarding other road signs, disregarding road markings, improper turning, right turn on red, improper lane change, improper lane use, passing on a hill, passing on a curve, other improper passing, failing to yield the right of way, improper or no signal, following a vehicle closely, and operating defective equipment are less likely to result in severe injury to other drivers when compared to disregarding a traffic signal.

The likelihood of severe injury to oneself when driving under the influence of alcohol and drugs is 15 and 7, respectively. However, the likelihood of severe injury to other drivers due to driving under the influence of alcohol and drugs is 4.6 and 5.3, respectively. Likewise, other drivers are exposed to slightly higher moderate injury due to driving under the influence of drugs than due to driving under the influence of alcohol. Disregarding a stop sign is more likely to put other drivers at severe risk compared to disregarding a traffic signal. Among the considered traffic violations, 7 are more likely to put other drivers at risk compared to disregarded traffic signals. Except for aggressive driving, all other traffic violations are more likely to result in moderate injury to other drivers. Overall, other drivers are unintentionally involved in crashes and are at risk because of traffic violators.

Discussion

A majority of the traffic violations have higher probabilities of resulting in severe driver injury compared to injury when disregarding traffic signals. Exceeding the speed limit is more likely to result in severe injury to the driver compared to driver injury due to disregarding traffic signals. However, going the wrong way is more likely to result in severe injury to other drivers compared to any other traffic violation. Driving under the influence of alcohol is 2 times more likely to result in severe injury to the driver than driving under the influence of drugs. The associated risk varies by the type of traffic violation. The risk drivers violating traffic rules pose to themselves is higher than the risk they pose to other drivers.

The findings from this study serve as documented evidence to educate and create awareness among drivers of the risk of violating traffic rules for themselves as well as for other drivers. Educating drivers about the risk associated with various traffic violations could help them develop safe driving behaviors, which would eventually improve safety on roads and contribute toward reaching the “zero traffic deaths” vision. The findings from this study could also be used by policy makers and transportation system managers to identify traffic violations that need to be immediately addressed to reduce both crashes and fatalities.

Traffic rule violators increase the risk to other road users. Penalty points may be imposed on their driver’s license, they may have to pay a fine, and they may have their license revoked depending upon the type of violation committed (whether the traffic violation leads to a crash or not). It is important to present the risk in terms of injury severity to themselves as well as other drivers (road users, in general) to define penalty points or fine.
amount. The findings from this research provide vital insights to integrate potential risk and validate or revise enforcement penalties (points and fine).

In this study, only drivers involved in crashes were taken into consideration for analysis and modeling. Subject to availability of quality data, the study could be extended to examine the effect of violating a traffic rule on passengers, pedestrians, and bicyclists.

Likewise, only the primary contributing factor or traffic violation was taken into consideration for analysis and modeling in this research. Certain combinations of multiple violations may increase risk to drivers and other road users. The risk could vary by gender, age group, lighting condition, and network characteristics. The effect of combinations of violations on risk to drivers and other road users by gender, age group, or other characteristics merits research and investigation in the future.

Drivers often perceive that violating a traffic rule does not lead to a crash or severe crash. However, the reality may be far different than what drivers often perceive. There is also a need to compare risk due to violating traffic rules by age and gender with risk perceptions by age and gender to identify and educate target groups whose perceptions substantially differ from the reality.

Acknowledgments

The authors appreciate the assistance and support of the staff of the Highway Safety Information System (HSIS) with the crash data required for this research. Special thanks are extended to Anusha Patel Nujiyetty, HSIS Lab Manager.

References

Abdel-Aty M. Analysis of driver injury severity levels at multiple locations using ordered probit models. J Safety Res. 2003;34:597–603.

Ayuso M, Guillen M, Alcaniz M. The impact of traffic violations on the estimated cost of traffic accidents with victims. Accid Anal Prev. 2010;42:709–717.

Ben-Akiva ME, Lerman SR. Discrete Choice Analysis: Theory and Application to Travel Demand. Cambridge, MA: The MIT Press; 1985.

Braitman KA, Kirley BB, Ferguson S, Chaudhary NK. Factors leading to older drivers’ intersection crashes. Traffic Inj Prev. 2007;8:267–274.

Campbell BN, Smith JD, Nazm WG. Analysis of Fatal Crashes Due to Signal and Stop Sign Violations. Washington, DC: NHTSA; US Department of Transportation; 2004. DOT HS 809 779.

Carson J, Manning F. The effect of ice warning signs on ice—accident frequencies and severities. Accid Anal Prev. 2001;33:99–109.

Council FM, Nujiyetty AP. Highway Safety Information Systems Guidebook for the North Carolina State Data Files. Washington, DC: Federal Highway Administration; 2014.

Cunningham RM, Maio RF, Hill EM, Zink BJ. The effects of alcohol on head injury in the motor vehicle crash victim. Alcohol Alcohol. 2002;37:236–240.

Drummer OH, Gerostamoulos J, Batziris H, et al. The involvement of drugs in drivers of motor vehicles killed in Australian road traffic crashes. Accid Anal Prev. 2004;36:239–248.

Factor R, Mahalel D, Yair G. Inter-group differences in road–traffic crash involvement. Accid Anal Prev. 2008;40:2000–2007.

Fosgerau M. Speed and income. Journal of Transport Economics and Policy. 2005;39:225–240.

Geedipally S, Turner P, Patil S. Analysis of motorcycle crashes in Texas with multinomial logit model. Transp Res Rec. 2011;2265:62–69.

Goldenbeld C, Reurings M, Van Norden Y, Stipdonk H. Crash involvement of motor vehicles in relationship to the number and severity of traffic offenses. An exploratory analysis of Dutch traffic offenses and crash data. Traffic Injury Prev. 2013;14:584–591.

Gonzalez-Iglesias B, Gomez-Fragucla JA, Luengo-Martin MA. Driving anger and traffic violations: Gender differences. Transp Res Part F Traffic Psychol Behav. 2012;15:404–412.

Islam S, Manning F. Driver aging and its effect on male and female single-vehicle accident injuries: Some additional evidence. J Safety Res. 2006;37(3):267–276.

Khorashadi A, Niemeier D, Shankar V, Manning F. Differences in rural and urban driver-injury severities in accidents involving large-trucks: an exploratory analysis. Accid Anal Prev. 2005;37:910–921.

Kline DW, Kline TJ, Fozard JL, Kosnik W, Schieber F, Sekuler R. Vision, aging, and driving: the problems of older drivers. J Gerontol. 1992;47:27–34.

Li G, Keyl PM, Smith GS, Baker SP. Alcohol and injury severity: reappraisal of the continuing controversy. J Trauma Acute Care Surg. 1997;42:562–569.

Machin MA, Sankey KS. Relationships between young drivers’ personality characteristics, risk perceptions, and driving behavior. Accid Anal Prev. 2008;40:541–547.

Malyshkina N, Manning F. Effect of increases in speed limits on severities of injuries in accidents. Transp Res Rec. 2008:2083:122–127.

Moyano-Diaz E. Evaluation of traffic violation behaviors and the causal attribution of accidents in Chile. Environ Behav. 1997;29:264–282.

National Center for Statistics and Analysis. 2013 Motor Vehicle Crashes: Overview. Washington, DC: NHTSA; 2014.

National Center for Statistics and Analysis. Speeding: 2013 Data. Traffic Safety Facts. Washington, DC: NHTSA; 2015. DOT HS 812 162.

Pai CW, Saleh W. Exploring motorcyclist injury severity in approach-turn collisions at T-junctions: focusing on the effects of driver’s failure to yield and junction control measures. Accid Anal Prev. 2008;40:479–486.

PBSJ. US 64-NC 49 Corridor Study (Raleigh to Statesville and Raleigh to Charlotte): Postcard Survey Technical Report. Raleigh, NC: North Carolina Department of Transportation; 2004. Available at: http://www.ncdot.gov/projects/us64phase1/download/us64-nc49_postcard_survey_report.pdf. Accessed April 8, 2016.

Retting RA, Weinstein HB, Solomon MG. Analysis of motor-vehicle crashes at stop signs in four US cities. J Safety Res. 2003;34:485–489.

Savolainen P, Ghosh I. Examination of factors affecting driver injury severity in Michigan’s single-vehicle–deer crashes. Transp Res Rec. 2008:2078:17–25.

Shankar V, Manning F. An exploratory multinomial logit analysis of single-vehicle motorcycle accident severity. J Safety Res. 1996;27(3):183–194.

Shinar D, Schechtman E, Compton R. Self-reports of safe driving behaviors in relationship to sex, age, education, and income in the US adult driving population. Accid Anal Prev. 2001;33:111–116.

Stoduto G, Vingilis E, Kapur BM, Sheu WJ, McLellan BA, Liban CB. Alcohol and drug use among motor vehicle collision victims admitted to a regional trauma unit: demographic, injury, and crash characteristics. Accid Anal Prev. 1993;25:411–420.

Waller PF, Stewart JR, Hansen AR, Stutts JC, Popkin CL, Rodgman EA. The potentiating effects of alcohol on driver injury. JAMA. 1986;256:1461–1466.

Yagil D. Gender and age-related differences in attitudes toward traffic laws and traffic violations. Transp Res Part F Traffic Psychol Behav. 1998;1(2):123–135.

Yamamura E. Impact of formal and informal deterrents on driving behavior. J Socio Econ. 2008;37:2505–2512.

Zhang G, Yau KK, Chen G. Risk factors associated with traffic violations and accident severity in China. Accid Anal Prev. 2013;59:18–25.

Zhou H, Zhao J, Pour-Rouholamin M, Tobias PA. Statistical characteristics of wrong-way driving crashes on Illinois freeways. Traffic Inj Prev. 2015;16:760–767.