Factors Affecting Motor Vehicle Crashes in Ohio

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Introduction
Ohio has the 10th largest roadway system in the United States. It also maintains the 5th largest traffic volume, and 4th largest truck traffic volume in the nation. There were 2,300,517 people involved in a MVC in Ohio during 2005-2007, yielding an annual average of 766,839. During 2005-2007, 3,927 Ohioans lost their lives as a result of a MVC-related injury, which is an average of 1,309 annually. There were 345,718 ED visits and 21,462 inpatient hospitalizations for MVC-related injuries during this period. MVC-related injury accounted for $689 million in hospital charges and more than 89,000 days of hospitalization. In addition, millions of dollars are lost annually in productivity, property damage, increased insurance costs, and municipal expenses, while the number of licensed drivers and registered vehicles in Ohio continues to grow.

Distracted driving, aggressive driving, and impaired driving have been identified as important contributors to MVCs nationally; however, the extent of the influence of these behaviors on MVC-related injuries and outcomes in Ohio is not well understood. This study defines the role of factors associated with these behaviors in MVC-related injuries and outcomes among Ohioans.

The study population of this investigation includes all individuals who are included in two large statewide datasets (Crash Information System Database and Emergency Department and In-patient Hospital Database) for the 6-year period, 2004 through 2009, for Ohio. We analyzed linked and unlinked data from these two datasets. Dataset linkage was performed using a sophisticated probabilistic linkage software application. This study provides a comprehensive understanding of the scope and magnitude of the injury problem associated with distracted driving, aggressive driving, and impaired driving in Ohio. These findings will help facilitate prevention of MVC-related injuries among Ohioans through informed public policy and evidence-based, targeted educational efforts in our state.
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Executive Summary

The Problem
Injuries are a leading cause of death and disability throughout the US and Ohio, and motor vehicle crashes (MVCs) are among the most common causes. MVC-related injury accounted for $689 million in hospital charges and more than 89,000 days of hospitalization in Ohio during 2005-2007. Distracted driving, aggressive driving, and impaired driving have been identified as important contributors to MVCs nationally; however, the extent of the influence of these behaviors on MVC-related injuries and outcomes in Ohio is not well understood.

Study Goals
This study describes the medical and economic impact of factors associated with distracted driving, aggressive driving, and impaired driving that affect MVC-related injuries to Ohioans.

Methodology
This investigation used two probabilistically linked statewide databases: the Ohio crash database and the Ohio emergency department and inpatient hospital database for the years 2004 through 2009. Any individual who was an occupant of a motor vehicle involved in a crash attributed to distracted driving, aggressive driving, or impaired driving was included in our study. Injury and death information was obtained from a combination of crash report and hospital records, and therefore, available for all vehicle occupants. However, hospital care information (e.g., injury type, severity, discharge status, hospital charges, and length of stay) was only available for injured occupants who linked to a hospital record.

Key Findings
From 2004 through 2009, there were 1,018,910 vehicle occupants in a crash involving distracted, aggressive or impaired driving in Ohio, and 17.7% of these occupants experienced an injury. Among younger drivers, the rate of crash incidents related to distracted, aggressive or impaired driving was 4,263.3 per 100,000 licensed drivers
ages 16 to 19 years, and 3,572.1 per 100,000 licensed drivers ages 20 to 24 years. Conversely, the crash incident rate among adults ages 50 to 59 years was only 964.9 per 100,000 licensed drivers. Drivers involved in fatal crashes due to distracted, aggressive or impaired driving were overwhelmingly male (79.5%; 621 per year). Nearly one-third (29.1%; 228) of fatal crashes due to distracted, aggressive or impaired driving involved drivers ages 20 to 29 years. More than one-half (52.8%; 413) of drivers who were fatally injured were involved in crashes occurring during the evening (8 pm to 12 am) or early morning (12 am to 6 am) hours.

Each year during 2004-2009, there were approximately 14,589 vehicle occupants involved in crashes attributed to distracted driving. More than one-half (56.5%) of occupants involved in distracted driving-related crashes were male. Each year, 14.8% of occupants involved in distracted driving-related crashes were injured, and nearly 32% of occupants injured in distracted driving-related crashes were ages 16 to 24 years. Distracted drivers were on average 39.9 years of age, and 58.1% were male. The rate of distracted driving-related crashes was 288.9 per 100,000 licensed drivers ages 16 to 19 years, compared with 103.6 per 100,000 licensed drivers ages 50 to 59 years. Occupants ages 16 to 19 years had 1.27 times greater odds of injury compared with occupants of all other ages. Vehicle occupants injured in distracted driving-related crashes spent 2,636 days in the hospital (439 per year), and accrued over $22.4 million in hospital charges ($3.7 million annually).

Each year during 2004-2009, there were approximately 136,856 vehicle occupants involved in crashes attributed to aggressive driving. More than one-half (56.8%) of occupants involved in aggressive driving-related crashes were male. Annually, 20,538 (15.0%) of occupants involved in aggressive driving-related crashes were injured as documented by the police report or hospital record. Nearly 60% of aggressive driving-related injuries occurred between 10 am and 8 pm, and 49.1% of injuries were sustained in a rear-end collision. More than one-third (37.3%) of injured vehicle occupants were ages 16 to 24 years. Males comprised 76.1% of fatal injuries due to aggressive driving. The rate of aggressive driving-related crashes was 3,787.1 per
100,000 licensed drivers ages 16 to 19 years and 2,909.4 per 100,000 licensed drivers ages 20 to 24 years. Comparatively, the rate among adults ages 50 to 59 years was 745.2 per 100,000 licensed drivers. “Exceeded speed limit” was more often cited in younger drivers and in rural areas, while “unsafe speed” was more common among older drivers and in urban crashes. During 2004-2009, vehicle occupants injured in aggressive driving-related crashes spent 28,366 days (4,728 per year) in the hospital and accrued more than $250.8 million ($42 million annually) in hospital charges.

Each year during 2004-2009, there were approximately 29,767 vehicle occupants involved in crashes attributed to impaired driving. Nearly 70% of occupants involved in impaired driving-related crashes were male. Only 78.3% of occupants involved in impaired driving-related crashes were utilizing proper safety restraints at the time of the crash. More than one-half (58.3%) of impaired driving-related injuries occurred between 8 pm and 6 am, and 39.7% occurred on a Saturday or Sunday. Males comprised 78.9% of deaths due to impaired driving-related crashes. More than one-third (34.3%) of occupants injured in impaired driving-related crashes were ages 20 to 29 years. Only 64.2% of injured occupants and 23.7% of fatally injured occupants were utilizing proper safety restraints. The rate of impaired driving-related crashes among licensed drivers peaked among young adults ages 20 to 24 years (686.4 per 100,000), and was lowest among older adults ages 60 years or older (94.3 per 100,000). Occupants injured in impaired driving-related crashes spent 29,379 days in the hospital (4,896 per year) and accrued nearly $300 million ($50 million annually) in hospital charges.

**Conclusions**

The findings of this study provide important Ohio-specific data, which demonstrate that injury and death related to distracted, aggressive and impaired driving is a serious and frequent public health problem in Ohio. Evidence-based, targeted prevention efforts aimed at reducing the morbidity and mortality associated with distracted, aggressive and impaired driving should continue to be implemented at the state and local levels in Ohio. Prevention efforts should focus on targeting specific age groups, particularly youth and young adults, with a higher prevalence of these risky driving behaviors.
Investigators and Project Personnel - Information/Qualifications

**Principal Investigator - Gary A. Smith, MD, DrPH** Dr. Gary Smith is a Professor of Pediatrics of the Ohio State University College of Medicine with joint faculty appointments in the Division of Epidemiology, College of Public Health, and in the Department of Emergency Medicine. He is founder and Director of the Center for Injury Research and Policy (CIRP) and is a pediatric emergency medicine physician at Nationwide Children’s Hospital in Columbus, Ohio. Dr. Smith is board certified in the specialties of pediatrics and general preventive medicine and public health, and in the subspecialty of pediatric emergency medicine. In addition to his clinical training, Dr. Smith holds Master of Public Health and Doctor of Public Health degrees from the Johns Hopkins Bloomberg School of Public Health. Dr. Smith is the principal investigator of the Ohio CODES program and several other ongoing injury research projects.

**Co-Investigator - Huiyun Xiang, MD, PhD, MPH** Dr. Xiang is an Associate Professor of Pediatrics in the Ohio State University College of Medicine and a research faculty member in CIRP. Dr. Xiang is an injury epidemiologist with advanced training in biostatistics. He has more than 15 years experience in large data management and statistical analysis. Dr. Xiang is the PI of several ongoing injury research projects, and is Co-PI of the Ohio CODES Program.

**Co-Investigator – Jonathan I. Groner, MD** Dr. Groner is a Clinical Professor of Surgery at the Ohio State University College of Medicine, the Medical Director of the Level 1 Pediatric Trauma Program at Nationwide Children’s Hospital, and an affiliate research faculty member in CIRP. He is a past president of the Central Ohio Trauma System.

**Project Research Manager – Kristen Conner, MPH** Ms. Conner has a MPH degree with a concentration in epidemiology from the Boston University School of Public Health. She has outstanding experience in conducting research, performing data analysis, and peer-reviewed publication. She has been a member of the CIRP data
linkage research team since 2006, and has extensive experience analyzing the statewide datasets and using the probabilistic matching software employed in this study.

**Literature Review**

**Introduction**

Injuries are a leading cause of death and disability throughout the United States and Ohio (NCIPC, 2009). In 2006, unintentional injuries were the fifth leading cause of death for Ohioans of all ages and the leading cause of death for Ohioans ages 1-44 years.¹ Most injuries do not result in death, but can have considerable long-term medical and economic consequences. Approximately one-third of all US emergency department (ED) visits and 8% of inpatient hospitalizations are the result of injuries. Based on analyses conducted by the Center for Injury Research and Policy, 20,112 Ohioans died from an injury during 2005-2007. Approximately 70% of these injury deaths were unintentional, and motor vehicle crashes (MVCs) were among the most common causes.

During 2005-2007, 3,927 Ohioans lost their lives as a result of a MVC-related injury, which is an average of 1,309 annually. There were 345,718 ED visits and 21,462 inpatient hospitalizations for MVC-related injuries during this period. MVC-related injury accounted for $689 million in hospital charges and more than 89,000 days of hospitalization. In addition, millions of dollars are lost annually in productivity, property damage, increased insurance costs, and municipal expenses, while the number of licensed drivers and registered vehicles in Ohio continues to grow. Distracted driving, aggressive driving, and impaired driving have been identified as important contributors to MVCs nationally; however, the extent of the influence of these behaviors on MVC-related injuries and outcomes in Ohio is not well understood. This study describes the medical and economic impact of factors associated with distracted driving, aggressive driving, and impaired driving that affect MVC-related injuries to Ohioans, with the long-term goal of preventing motor vehicle crash-related morbidity and mortality.
**Background**
In Ohio, more than 2.3 million people were involved in a motor vehicle crash in 2005-2007. Of these, nearly 375,000 individuals sustained a possible, non-incapacitating, incapacitating, or fatal injury. Behavioral factors such as distracted driving, aggressive driving, and impaired driving are important contributors to motor vehicle-related death and disability.

Distracted driving involves visual, manual, or cognitive distraction. It includes activities such as eating or drinking, cell phone use, texting, use of in-vehicle technology and mobile electronic devices, grooming, reading, talking with passengers, and coping with strong emotions. Based on police crash reports, an estimated 515,000 individuals were injured and 5,870 died in crashes involving driver distraction in 2008 in the US, representing 16% of all crash fatalities that year. An estimated 21% (2.4 million) of all injury crashes involved a distracted driver. The youngest age groups had the greatest proportion of distracted driver-related fatalities: 16% among drivers 19 years of age or younger, and 12% among drivers 20 to 29 years of age. The proportion of distracted drivers involved in fatal collisions has increased in recent years, rising from 8% in 2004 to 11% in 2008. Findings from the 100-Car Naturalistic Driving Study by the National Highway Traffic Safety Administration (NHTSA) demonstrated that driver inattention is the leading factor in most crashes and near-crashes. Almost 80% of crashes and 65% of near-crashes involved some type of driver inattention within three seconds before the event. The study found that 22% of recorded crashes and near-crashes involved drivers engaged in secondary tasks. In 2008, NHTSA’s National Occupant Protection Use Survey (NOPUS) observed 1.0% of drivers manipulating hand-held electronic devices, which was an increase from 0.7% in 2007. Among drivers 16-24 years of age, 1.7% was observed using these devices, which was increased from 1.0% in 2007. Based on NOPUS, at any given moment during the daytime on US roadways, there are an estimated 812,000 vehicles being driven by someone using a hand-held cell phone. Use of a cell phone slows the response to braking of a vehicle ahead by 18%. More than one-fourth (26%) of US teenagers of driving age admit to texting while driving, and
almost half (48%) of 12-17 year-olds state that they have ridden in a motor vehicle while the driver was texting.²

Aggressive driving is another important factor in MVC-related death and injury. NHTSA defines aggressive driving as “when individuals commit a combination of moving traffic offenses so as to endanger other persons or property.” Aggressive driving includes behaviors such as speeding, following too closely, erratic or unsafe lane changes, lane changes without proper signaling, and failure to obey traffic control signs or devices. NHTSA considers red light running and speeding to be among the most dangerous behaviors of aggressive driving. Speed is a contributing factor in nearly one-third of all fatal crashes, averaging 1,000 deaths each month nationally. Two-thirds of speed-related fatal crashes occur between 6pm and 6am, and most (60%) occur on rural roads. Young male drivers are disproportionately represented among speed-related crash fatalities. Among fatally injured drivers younger than 21 years of age, speed was a factor for 38% of male and 24% of female drivers. Sixty percent of speed-related crashes are single-vehicle crashes. Speed-related crashes cost society more than $23 billion a year, which equals more than $44,000 per minute.³ In a 1997 telephone survey by NHTSA, approximately two-thirds of drivers admitted to at least occasionally exceeding what they consider to be the maximum safe speed on roads they travel regularly. During the previous week, drivers reported entering an intersection just as the light was turning red (30%), did not completely stop at a stop sign (26%), drove 10 mph greater than the speed limit on an interstate (23%), drove 10 mph faster than most other vehicles (22%), and raced another driver (6%).⁴

Impaired driving is another key factor contributing to MVC-related deaths and injuries nationally and in Ohio. In 2007, 12,998 people died in highway crashes involving a driver with a Blood Alcohol Concentration (BAC) of 0.08 or higher, which represents one fatality every 40 minutes. Of the 6,159 passenger vehicle drivers 21-34 years of age who were killed in MVCs in 2007, 51% had a BAC of 0.08 or greater. The fatality rate per 100 million vehicle miles traveled associated with alcohol-related driving impairment was 0.43 in 2007.⁵ The proportion of alcohol-related crash fatalities (where at least one
driver and/or non-occupant involved had a BAC of 0.08 or higher) decreased steadily from 53% in 1982 to 34% in 1997, and has since leveled off. When only drivers are considered, the proportion of drivers in fatal crashes with a BAC of 0.08 or greater decreased from 35% in 1982 to 20% in 1997, and then leveled off.\textsuperscript{6} In 2007, NHTSA conducted a national roadside survey of alcohol and drug use by drivers and found a prevalence of 2.2% of drivers at or above the legal BAC limit. This represented a decline from previous national surveys. Male drivers more commonly exceeded the legal BAC limit than female drivers. As part of this survey, saliva and blood samples were tested for potentially impairing drugs, including illegal, prescription, and over-the-counter medications, including marijuana, narcotic analgesics, sedatives, stimulants, and antidepressants. Based on saliva samples, nighttime drivers were drug-positive 14.4% of the time compared with 11.0% of daytime drivers. Blood samples were obtained from drivers only at night, and 13.8% of these tested drug-positive. Overall, 16.3% of nighttime drivers were drug-positive for either or both saliva and blood tests. Although drug presence does not necessarily mean driving impairment, these findings are provocative.\textsuperscript{7}

Drowsy driving is a serious type of impaired driving that accounts for approximately 56,000 crashes, 40,000 non-fatal injuries, and 1,550 fatalities annually in the U.S. Sleepiness impairs performance behind the wheel and ultimately can lead to falling asleep while driving. Sleepiness results in driving impairment due to decreased vigilance and attention, slower reaction time, and altered information processing. Crashes related to drowsy driving typically occur during late night/early morning or mid-afternoon, involve a single vehicle leaving the roadway, occur on a high-speed road without an attempt by the driver to avoid the crash, involve a driver as the only vehicle occupant, and result in severe injury. Risk factors include loss of sleep, driving late at night (12 am to 6 am) or mid-afternoon (especially among elder drivers), driving many hours or long distances, use of sedating medications and/or alcohol, and having an untreated sleep disorder. High risk groups include young drivers (16-29 years of age), shift workers, and individuals with sleep apnea syndrome and narcolepsy.\textsuperscript{8}
**Historical Perspectives**

The Ohio Commission on the Prevention of Injury was convened by the Ohio Department of Health from 2001-2003 to evaluate the status of injury in Ohio with particular emphasis on the pediatric and geriatric populations. The Injury Commission’s final report, titled “Injury in Ohio: A Report of the Ohio Commission on the Prevention of Injury” (URL: [http://www.ohio.gov/trauma/injprevcommreports.htm](http://www.ohio.gov/trauma/injprevcommreports.htm)), did not include a comprehensive analysis of Ohio-specific injury data, especially injury morbidity data. This was primarily due to difficulty in accessing some databases, such as the proprietary emergency department and hospital inpatient database of the Ohio Hospital Association, and the lack of linked statewide databases. The Injury Commission recognized the need for expansion and improvements in the use of injury surveillance data in Ohio, and one of its core recommendations was the linkage of existing statewide databases. Linkage of these databases was begun in 2004 with the initiation of the Ohio CODES Program. Ohio legislators invariably request Ohio-specific injury data when considering legislation to prevent injury among Ohioans, and these data have often been unavailable in the past.

**Current Status**

Distracted driving, aggressive driving, and impaired driving have been identified as important contributors to MVCs nationally; however, the extent of the influence of these behaviors on MVC-related injuries and outcomes in Ohio is not well understood. This study provides a comprehensive and detailed evaluation of the medical and economic impact of distracted driving, aggressive driving, and impaired driving in Ohio. Our hope is that the findings of this study will help promote prevention of MVC-related injuries among Ohioans through informed public policy and evidence-based, targeted educational efforts.

**Regional and National Trends**

The factors and trends associated with distracted driving, aggressive driving, and impaired driving have been described above under the background section. We hope that the findings of this study will help inform prevention efforts so that future trends will
reflect a decline in injuries associated with distracted driving, aggressive driving, and impaired driving.

Financial Issues and Considerations
Not applicable to this research project.

Education and Training Issues and Considerations
Not applicable to this research project.

Legislative and Regulatory Issues and Considerations
Not applicable to this research project

Data Issues and Considerations

Data Sources
This investigation used two large statewide databases for Ohio. The Ohio Department of Public Safety crash database contains all reported crash incidents that involve an injury event or property damage in excess of $400. Approximately 350,000 crashes are reported to this database by Ohio law enforcement agencies annually. The Ohio Hospital Association database includes all emergency department (ED) and inpatient admissions reported by the approximately 174 member hospitals. Records containing a diagnosis code in the range of 800.00-960.00 or an E-code indicating an external cause of injury (E800-E999, or V714) according to the 9th Revision of the International Classification of Diseases, Clinical Modification (ICD-9-CM) were selected for data linkage.

Study Population
The Ohio crash database and Ohio hospital database for the years 2004 through 2009 were probabilistically linked using CODES2000 software to create an extensive new combined research data set for analysis. This sophisticated probabilistic linkage procedure includes multiple imputation of missing links to reduce potential bias in the combined research data set.
Variable Description

Variables in this study were derived from information contained in police reports and/or hospital records. An individual was considered injured if either the police report or hospital record indicated an injury. For those individuals with a linked hospital record, the primary cause of injury was defined as the first-listed E-code in the hospital record. For the purposes of this analysis, we excluded those cases with an external cause of injury classified as the adverse effects of medical care or drugs (E870-E879, E930.0-E949.9). For individuals involved in motor vehicle crashes without a linked hospital record, a death was said to have occurred if the police report indicated a fatality. For those with a linked hospital record, a death was said to have occurred if hospital discharge information indicated a fatality.

Hospital care and economic information, including length of stay and hospital charges, was only available for injured individuals with a linked hospital record. Barell Matrix classification from injury diagnosis codes was used to determine the nature of injury (e.g., fracture) and body region injured (e.g., torso). For the classification of traumatic brain injury (TBI), the Barell Matrix describes three TBI severity categories: severe (type 1), moderate (type 2), and mild (type 3). This study also classifies ICD-9-CM 959.01 (head injury, unspecified) as a TBI, in accordance with the Centers for Disease Control and Prevention’s TBI definition and refers to this group as potential TBI when presenting TBI severity levels. Injury Severity Score (ISS) was determined from injury diagnosis codes using ICDMAP-90 software. In order to make more accurate comparisons, hospital charges were adjusted for inflation using the Hospital Services Consumer Price Index (CPI) published by the Bureau of Labor Statistics. All estimates of charges presented in this report are in 2009 dollars. Except where noted, incidences presented in this report are annual averages over the study period. So as not to introduce additional rounding bias, percentages are based on non-missing totals over the entire six-year period, rather than on annual averages.

Descriptive crash and occupant information, such as gender, age, restraint use, and motor vehicle type, was obtained from the crash report. In addition, the crash report
was used to classify crashes as being related to distracted driving, aggressive driving, impaired driving, or none of the above. An individual was determined to be involved in a distracted driving-related crash if the driver was noted with (1) driver inattention. An aggressive driving-related crash was defined by driver behavior to include (1) operating vehicle in erratic/reckless/careless/negligent/aggressive manner, (2) exceeded speed limit, (3) unsafe speed, or (4) followed too closely. Impaired driving was defined by driver behavior to include (1) fatigue/asleep, (2) depressed or angry emotional state, (3) illness, (4) under influence of medications/alcohol/drugs, or (5) alcohol/drugs suspected. Information on distracted, aggressive or impaired driving was not available for bicyclists or pedestrians, and as a result, these individuals were not included in our analyses. Whether or not a vehicle occupant was alone in the vehicle was determined from the number of occupants. Metropolitan area was determined from the county where the crash occurred and US Department of Agriculture definitions of metropolitan and non-metropolitan counties.\textsuperscript{17}

**Data Analyses**

SAS version 9.2 was used to generate descriptive statistics (frequencies, means, medians, ranges), and to conduct logistic and linear regression model analyses to determine the influence of selected risk/protective factors on health and economic outcomes. Our data analytic strategy included multiple imputation of missing values, with analysis conducted on five imputed data sets using the SAS MIanalyze procedure.

US census data for the state of Ohio were used to calculate average annual injury rates per 100,000 persons. Census counts for 2004, 2005, 2006, 2007, 2008, and 2009 were averaged together to obtain the average annual population in Ohio over the six-year study period. The rates of crash incidents related to distracted, aggressive or impaired driving for drivers were determined using the number of licensed drivers in Ohio in 2009.\textsuperscript{18}
Limitations
There were some limitations to this research investigation. The crash database included uninjured individuals who were not expected to link to a hospital record; however, it is likely there were some injured individuals who received hospital care for whom our probabilistic linkage techniques were unable to link their crash and hospital records. Simulated data linkages using parameters that mimic those of the Ohio databases have indicated that we are able to detect 83% of the true links. Our analysis using hospital data only included individuals who had a crash and hospital record link. Further, we were unable to ascertain medical outcome of individuals who sought care at an urgent care center or physician office. Hospital charges in this study represent billed hospital charges, rather than hospital costs and do not include other hospital-related charges, such as physician fees. Thus, the financial information presented likely underestimates the true economic impact of these injuries. Definitions for distracted, aggressive and impaired driving were based on documentation for available variables in the crash database, and it is likely that this method underestimated the true numbers of crashes where these factors played a role. Additionally, our metropolitan area variable would be more precise if obtained directly from the police report; however, this information is not available in Ohio and therefore, derived estimates were made based on the county in which the crash occurred.

Research Findings
From 2004 through 2009, there were 1,018,910 vehicle occupants in a crash involving distracted, aggressive or impaired driving in Ohio, and 17.7% of these occupants experienced an injury. Among younger drivers, the rate of crash incidents related to distracted, aggressive or impaired driving was 4,263.3 per 100,000 licensed drivers ages 16 to 19 years, and 3,572.1 per 100,000 licensed drivers ages 20 to 24 years. Conversely, the crash incident rate among adults ages 50 to 59 years was only 964.9 per 100,000 licensed drivers. Drivers involved in fatal crashes due to distracted, aggressive or impaired driving were overwhelmingly male (79.5%; 621 per year). Nearly one-third (29.1%; 228) of fatal crashes due to distracted, aggressive or impaired driving involved drivers ages 20 to 29 years. Only two-fifths (43.8%; 342) of drivers
involved in fatal crashes were utilizing proper safety restraints. More than one-half (52.8%; 413) of drivers who were fatally injured were involved in crashes occurring during the evening (8 pm to 12 am) or early morning (12 am to 6 am) hours. Nearly three-fourths (71.0%; 555) of fatal crashes due to distracted, aggressive or impaired driving occurred in urban areas.

**Distracted Driving**

Each year during 2004-2009, there were, on average, approximately 14,589 vehicle occupants involved in crashes due to distracted driving.

- 56.5% of occupants involved in distracted driving-related crashes were male.
- Youths and young adults ages 16 to 24 years accounted for 25.4% of vehicle occupants involved in distracted driving-related crashes.
- Each year, 14.8% of occupants involved in distracted driving-related crashes were injured.
- Nearly 32% of occupants injured in distracted driving-related crashes were ages 16 to 24 years.
- Distracted drivers were on average 39.9 years of age, and 58.1% were male.
- The rate of distracted driving-related crashes was 288.9 per 100,000 licensed drivers ages 16 to 19 years, compared with 103.6 per 100,000 licensed drivers ages 50 to 59 years.
- Motorcyclists had 6.28 times greater odds of death compared to occupants of other vehicles.
- Occupants in the front seat had 2.71 greater odds of death compared to occupants in the rear.
- Females had 1.36 times greater odds of injury when involved in a distracted driving-related crash compared with males.
- Occupants ages 16 to 19 years had 1.27 times greater odds of injury compared with occupants of all other ages.
- 98.4% of occupants receiving hospital care for distracted driving-related injuries had an ISS <16, but 1.6% experienced more serious injuries (ISS>16).
Occupants involved in crashes occurring between 6 am and 10 am had 1.85 times greater odds of a high ISS compared with those involved in crashes between 10 am and 4 pm.

Vehicle occupants injured in distracted driving-related crashes spent 2,636 days in the hospital (439 per year), and accrued over $22.4 million in hospital charges ($3.7 million annually).

**Aggressive Driving**

Each year during 2004-2009, there were, on average, approximately 136,856 vehicle occupants involved in crashes due to aggressive driving.

- 56.8% of occupants involved in aggressive driving-related crashes were male.
- Youth and young adults ages 16 to 24 years accounted for 34.8% of occupants involved in aggressive driving-related crashes.
- Annually, 20,538 (15.0%) of occupants involved in aggressive driving-related crashes were injured as documented by the police report or hospital record.
- 59.8% of aggressive driving-related injuries occurred between 10 am and 8 pm.
- 49.1% of injuries were sustained in a rear-end collision, and another 41.8% were sustained in a collision that did not involve two vehicles in transport. Only 2.1% involved head-on collisions.
- 37.3% of injured vehicle occupants due to aggressive driving were ages 16 to 24 years.
- Males comprised 76.1% of fatal injuries due to aggressive driving.
- The rate of aggressive driving-related crashes was 3,787.1 per 100,000 licensed drivers ages 16 to 19 years and 2,909.4 per 100,000 licensed drivers ages 20 to 24 years. Comparatively, the rate among adults ages 50 to 59 years was 745.2 per 100,000 licensed drivers.
- "Exceeded speed limit" was more often cited in younger drivers and in rural areas, while "unsafe speed" was more common among older drivers and in urban crashes.
- Youth ages 0 to 19 years had 0.68 times lower odds of death when involved in aggressive driving-related crashes compared to adults ages 40 to 59 years.
• Males had 1.42 times greater odds of death compared to females.
• Front seat occupants had 2.26 times greater odds of death compared to occupants seated in the rear of the vehicle.
• Greater odds of injury were noted for occupants involved in aggressive driving-related crashes occurring between 12 am and 6 am (OR=1.92), 8 pm and 12 am (OR=1.37) and 6 am and 10 am (OR=1.22) compared with those in crashes occurring between 10 am and 4 pm.
• 98.0% of those receiving hospital care for injuries sustained in aggressive driving-related crashes had mild of moderate injuries (ISS<16), but 2.0% sustained more serious injuries (ISS≥16).
• Youth and young adults injured in aggressive driving-related crashes had lower odds of high ISS compared with older occupants.
• During 2004-2009, vehicle occupants injured in aggressive driving-related crashes spent 28,366 days (4,728 per year) in the hospital and accrued more than $250.8 million ($42 million annually) in hospital charges.

Impaired Driving
Each year during 2004-2009, there were, on average, approximately 29,767 vehicle occupants involved in crashes due to impaired driving.
• 69.1% of occupants involved in impaired driving-related crashes were male.
• Only 78.3% of occupants involved in impaired driving-related crashes were utilizing proper safety restraints at the time of the crash.
• 58.3% of impaired driving-related injuries occurred between 8 pm and 6 am, and 39.7% occurred on a Saturday or Sunday.
• 66.8% of injuries were sustained in a collision that did not involve two vehicles in transport.
• Males comprised 78.9% of deaths due to impaired driving-related crashes.
• 34.3% of occupants injured in impaired driving-related crashes were ages 20 to 29 years.
• Only 64.2% of injured occupants and 23.7% of fatally injured occupants were utilizing proper safety restraints.
• The rate of impaired driving-related crashes among licensed drivers peaked among young adults ages 20 to 24 years (686.4 per 100,000), and was lowest among older adults ages 60 years or older (94.3 per 100,000).
• Males had 1.21 times greater odds of death compared with females when involved in an impaired driving-related crash.
• Youth experienced lower odds of death when involved in an impaired driving-related crash compared with older adults, but greater odds of injury.
• TBI was sustained by 20.0% of injured occupants receiving hospital care.
• 95.8% of injured individuals sustained mild/moderate injuries (ISS<16), but 4.2% experienced more serious injuries (ISS≥16).
• Motorcyclists had 2.94 greater odds of high ISS compared with occupants of other vehicle types.
• Occupants injured in impaired driving-related crashes spent 29,379 days in the hospital (4,896 per year) and accrued nearly $300 million ($50 million annually) in hospital charges.

Conclusions
The findings of this study provide important Ohio-specific data, which demonstrate that injury and death related to distracted, aggressive and impaired driving is a serious and frequent public health problem in Ohio.

Recommendations
Evidence-based, targeted prevention efforts aimed at reducing the morbidity and mortality associated with distracted, aggressive and impaired driving should continue to be implemented at the state and local levels in Ohio. Prevention efforts should focus on targeting specific age groups, particularly youth and young adults, with a higher prevalence of these risky driving behaviors.
References


15. ICDMAP-90 software. Baltimore, MD: Johns Hopkins University & Tri-Analytics, Inc.

