

**Traumatic Brain Injury Deaths, Hospitalizations
and Emergency Department Visits
in New Mexico, 2007-2011**

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Introduction

Traumatic brain injury (TBI) is caused by a blow to the head or a penetrating head injury that disrupts brain function. It can affect memory, judgment, sleep patterns, reflexes, speech, coordination, balance and behavior (personality changes, aggression, acting out, etc.). TBIs may range from mild to severe. Most cases of TBI are concussions or other types of mild TBI¹.

Many people with mild to moderate head injuries who experience cognitive deficiencies can become easily confused or distracted and have problems with concentration and attention². They may also have difficulty with higher level executive functions such as planning, organizing, abstract reasoning, problem-solving, and making judgments². Problems with cognition and higher level executive function may also make work-related activities more difficult to perform².

Over 1.7 million people sustain a TBI in the United States each year¹, of whom about 52,000 die, 275,000 are hospitalized, and 1,365,000 are treated and released from an emergency department¹. Direct medical costs and indirect costs of TBI, such as lost productivity, totaled an estimated \$60 billion in the United States in 2000⁵. Current estimates suggest that about 3.2-5.3 million persons (1.1%-1.7% of the U.S. population) live with long-term disabilities that result from TBI³⁻⁴.

This report examines five years of TBI deaths from 2007 through 2011 and TBI hospitalizations for the years 2009-2011. Starting in 2009, the diagnostic fields in the hospital discharge data increased from nine fields to eighteen fields. The external cause of injury code (E-code) fields increased from one field to three fields. E-codes designate the cause of the injury hospitalization, such as a fall or motor vehicle traffic injury. The addition of the E-code fields resulted in an increase in the percentage of injury hospital discharges that were E-coded from around 65% prior to 2009 to 84% in 2009. In 2010 and 2011, 93% of injury hospitalizations were E-coded.

The multiple-cause-of-death files for the years 2007-2011 were obtained from the NM Bureau of Vital Records and Health Statistics, New Mexico Department of Health (NMDOH). TBI-related deaths and their external causes in New Mexico were determined by using the case definition for TBI deaths recommended by the Centers for Disease Control and Prevention (CDC) and were based on the International Classification of Disease Version 10 (ICD-10). The population was obtained from the University of New Mexico Geospatial and Population Studies Group. The non-Hispanic White population is reported as "White". The Hispanic population category included persons whose race is "White" or "Other". The appendix contains the list of the ICD-10 diagnosis codes that were used to identify TBI deaths among NM residents for 2007-2011.

The number and rate of TBI-related injury deaths were calculated for this report. Data were stratified by age group, gender, race/ethnicity and external cause. TBI-related death rates were age-adjusted to the 2000 standard US population where comparisons were made between the New Mexico and U.S. rates and between the rates among racial/ethnic groups.

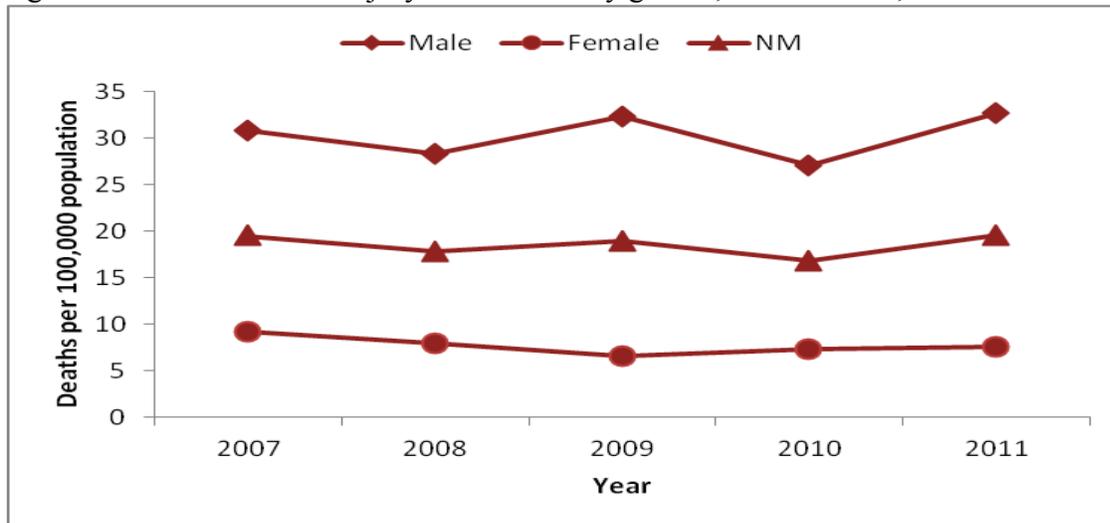
The hospital inpatient discharge data (HIDD) for the years 2009-2011 were obtained from the Morbidity Surveillance Program, NMDOH. The HIDD does not include hospitalizations from

the Veterans Administration and Indian Health Service hospitals in NM, and does not include hospitalizations of NM residents that occurred at out-of-state hospitals. TBI-related hospitalizations in NM were determined by using the case definition for TBI hospitalizations recommended by the CDC and were based on the International Classification of Disease Version 9 (ICD-9-CM). The appendix contains the list of the ICD-9-CM diagnosis codes that were used to identify TBI hospitalizations among NM residents for 2009-2011. The number and rate of TBI-related injury hospitalizations were calculated for this report. Data were stratified by age group, gender and external cause. TBI-related hospitalization rates were age-adjusted to the 2000 standard US population where comparisons were made between the causes of TBI injury hospitalizations. Emergency Department (ED) visit data for 2010 were obtained from the Morbidity Surveillance Program, NMDOH.

TBI-related Deaths

In NM, TBI-related deaths represented approximately one quarter of all injury-related deaths.

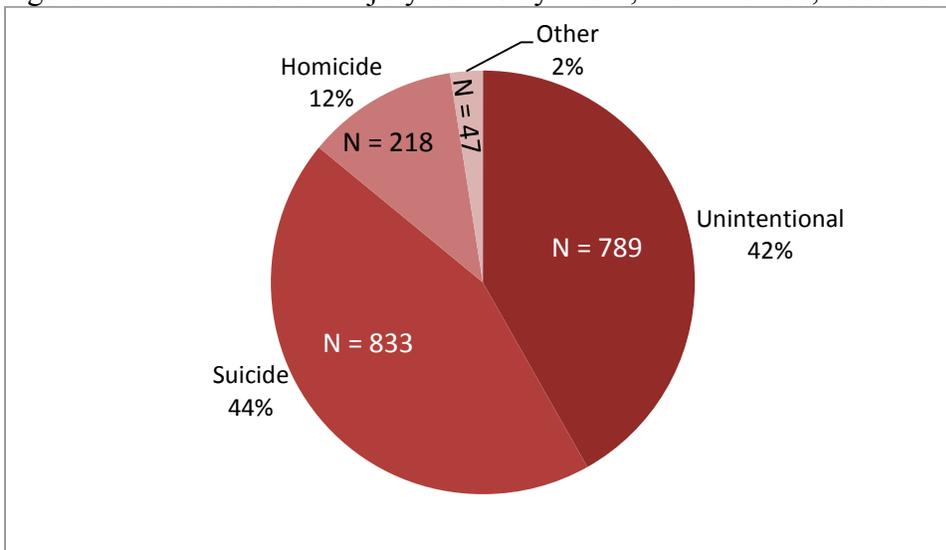
Figure 1. Traumatic brain injury death rates* by gender, New Mexico, 2007-2011



*Age-adjusted to the 2000 Standard US population

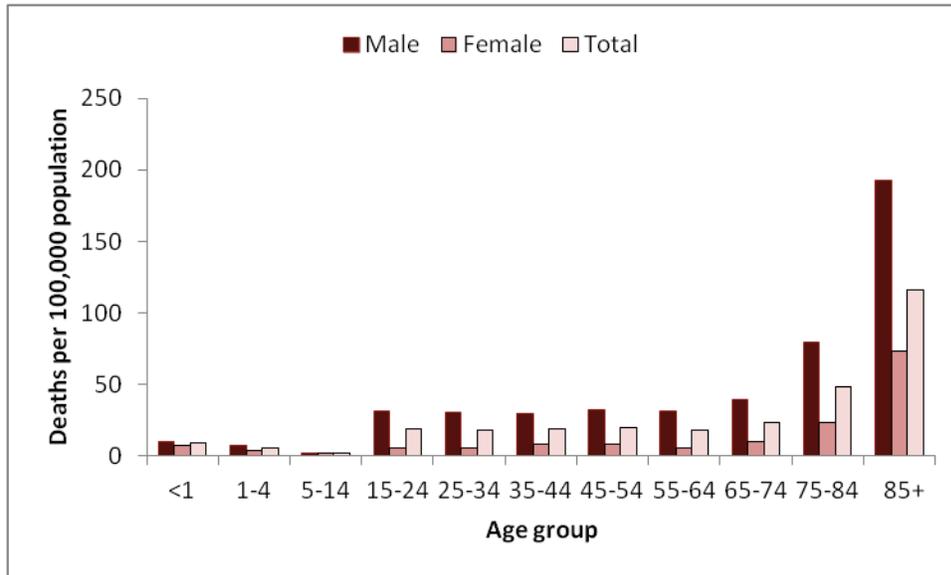
During 2007-2011, an annual average of 377 TBI-related deaths occurred among NM residents. During this period, TBI-related death rates in NM ranged from 16.8/100,000 population to 19.6/100,000. The male TBI-related death rate for 2007-2011 was, on average, four times higher than the rate among females.

Figure 2. Traumatic brain injury deaths by intent, New Mexico, 2007-2011



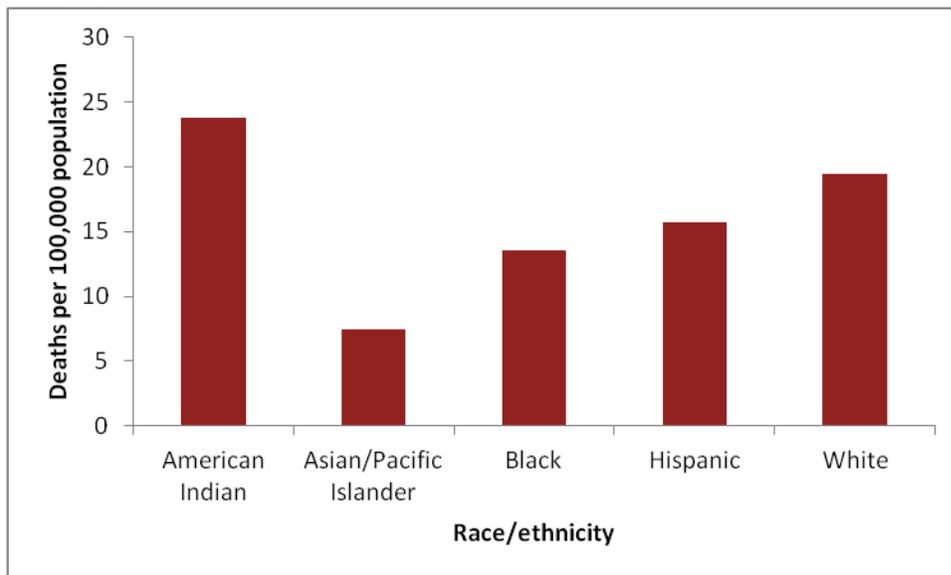
TBI-related deaths can be classified by the intent of the injury. Intentional injuries (suicide and homicide) accounted for over half of the TBI-related deaths in New Mexico. The “Other” category includes deaths of undetermined intent and those due to legal intervention.

Figure 3. Average annual traumatic brain injury death rates, by age and gender, New Mexico, 2007-2011



The TBI-related death rate for 2007-2011 was highest among persons 85+ years of age. During each year, the TBI-related death rate among males was higher than the rate among females, except for the youngest age groups, <1, 1-4 and 5-14 year olds. Among these age groups, females had a higher TBI-related death rate than males for some of the years.

Figure 4. Average annual traumatic brain injury death rates* by race/ethnicity, New Mexico, 2007-2011



*Age-adjusted to the 2000 Standard US population

American Indians/Alaska Natives (AI/ANs) had the highest average annual TBI-related death rate during 2007-2011. The AI/AN TBI-related death rate was 1.2 times higher than the rate among whites and 1.5 times higher than the rate among Hispanics. Asians/Pacific Islanders had the lowest TBI-related death rate followed by blacks.

New Mexico Health Regions

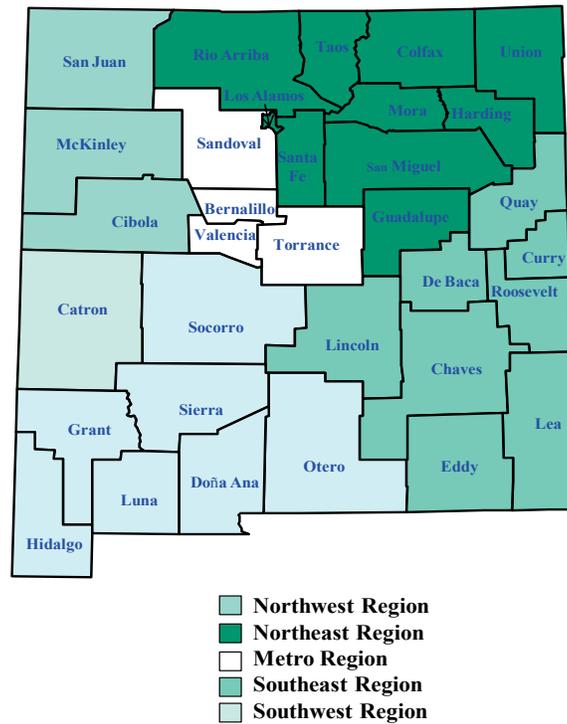
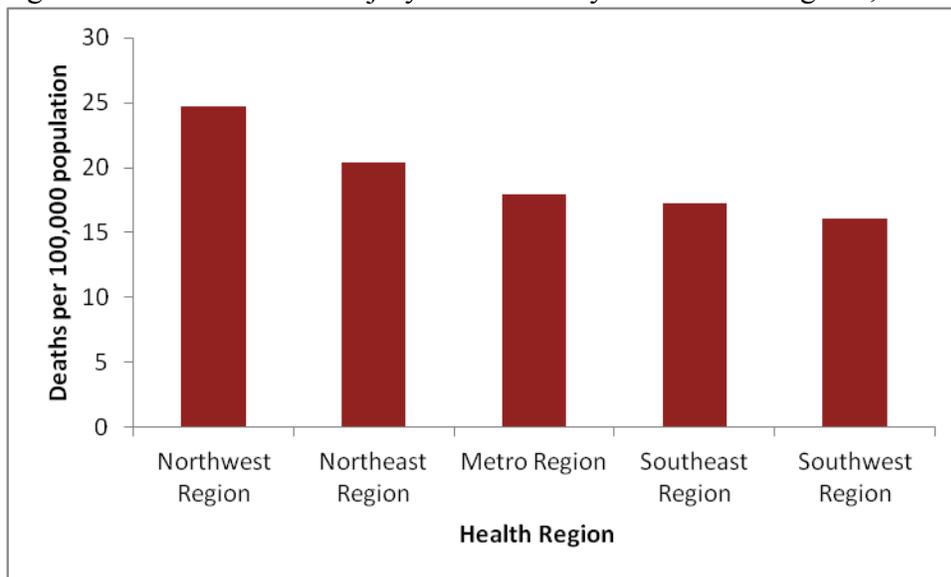


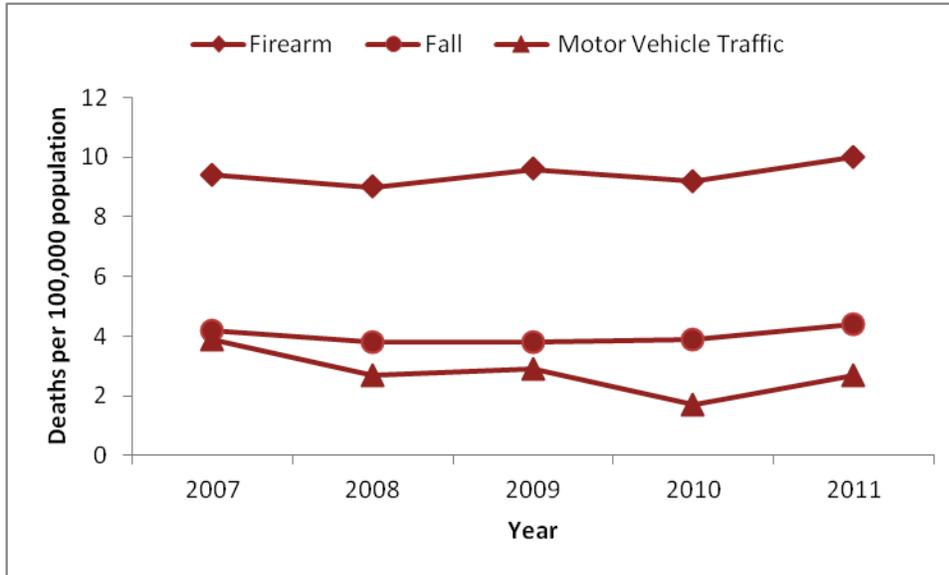
Figure 5. Traumatic brain injury death rates by NM Health Regions, New Mexico, 2007-2011



TBI-related death rates by health region are shown in Figure 5. The northwest region had the highest TBI-related death rate.

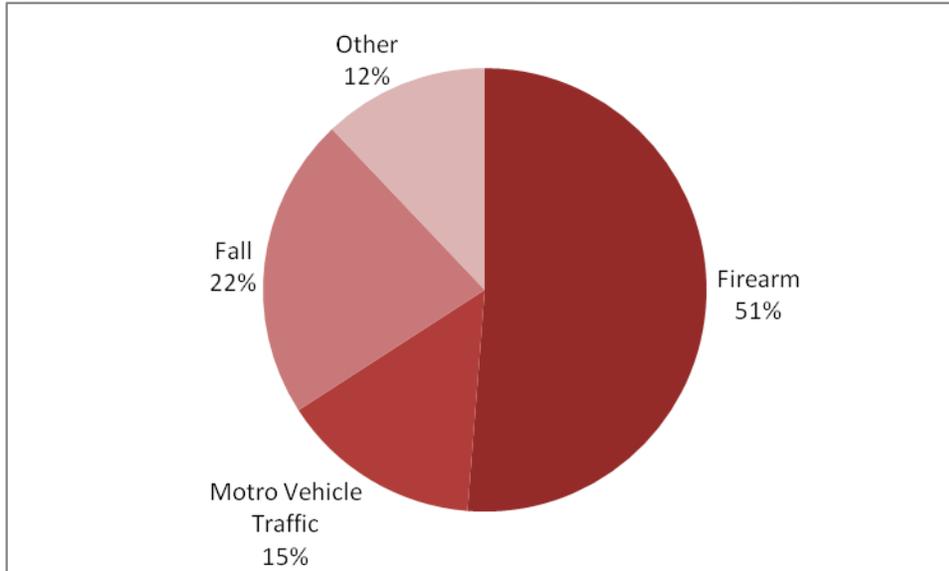
Mechanisms of TBI-Related Deaths

Figure 6. Traumatic brain injury death rates by year and external cause of injury, New Mexico, 2007-2011



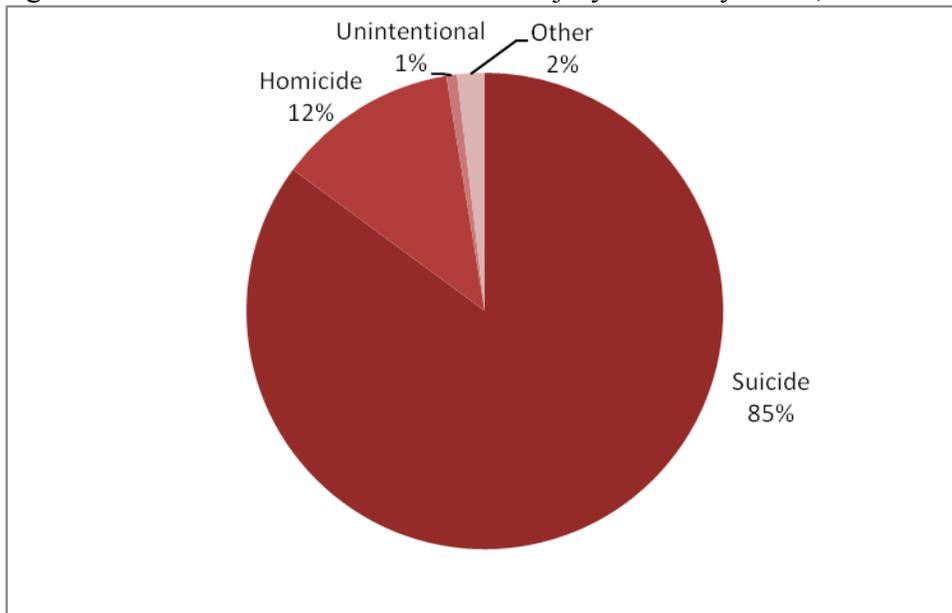
During 2007-2011 firearms, falls and motor vehicle traffic were the leading causes of TBI-related death in NM. In 2007, falls surpassed motor vehicle traffic as the second leading cause of TBI-related death. During 2007-2011, the motor vehicle traffic-related TBI death rate decreased 31%.

Figure 7. Traumatic brain injury deaths by external cause of injury, New Mexico, 2007-2011



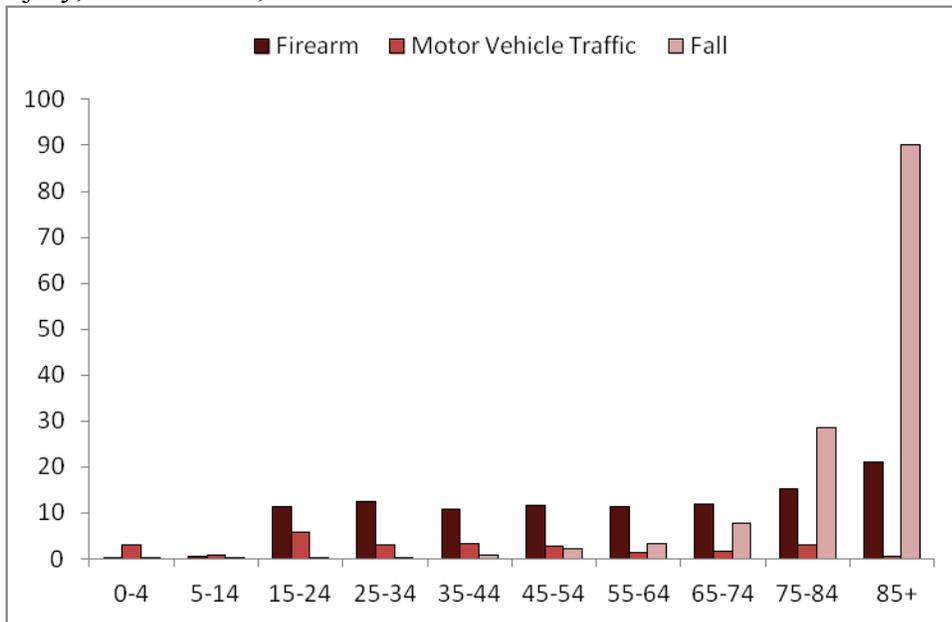
Over half of the TBI deaths during 2007-2011 were caused by firearms. Firearms, falls and motor vehicle traffic injuries accounted for 88% of the TBI-related deaths. The “Other” category includes injuries classified as other specified and classifiable, other specified, not elsewhere classifiable and unspecified as well as other causes including struck by, or against an object.

Figure 8. Firearm-related traumatic brain injury deaths by intent, New Mexico, 2007-2011



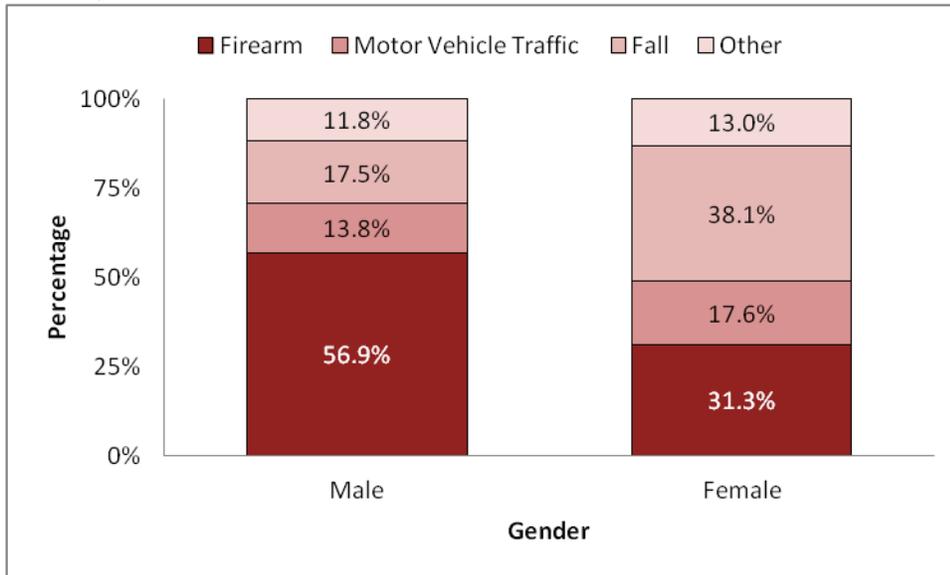
Most of the firearm-related TBI deaths were suicides.

Figure 9. Average annual traumatic brain injury death rates by age group and external cause of injury, New Mexico, 2007-2011



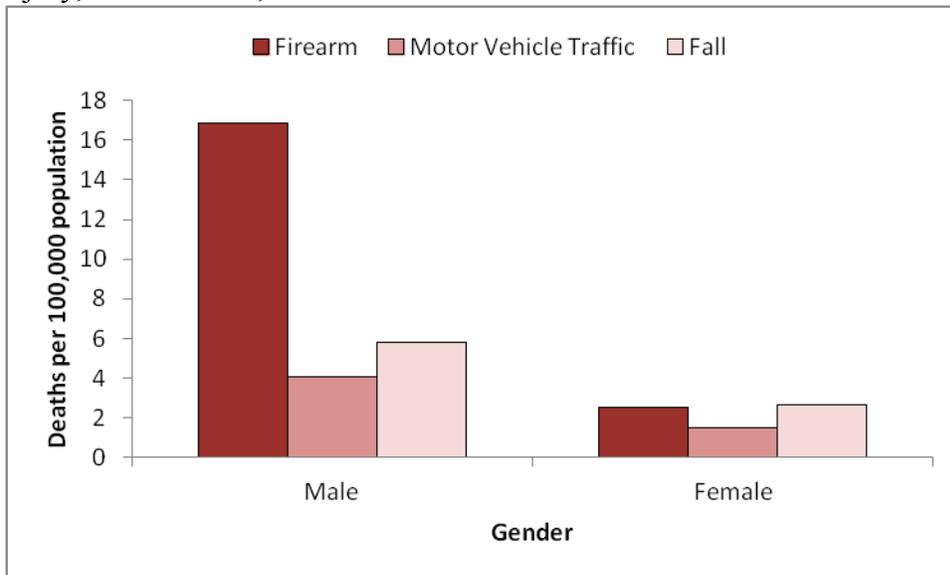
During 2007-2011, the firearm-related TBI death rate was highest among 85+ year olds. The motor vehicle traffic-related TBI death rate was highest among 15-24 year olds. The fall-related TBI death rate was highest among 85+ year olds. Fall-related injury accounted for 78% of TBI deaths in this age group.

Figure 10. Percentage of traumatic brain injury deaths by gender and external cause, New Mexico, 2007-2011



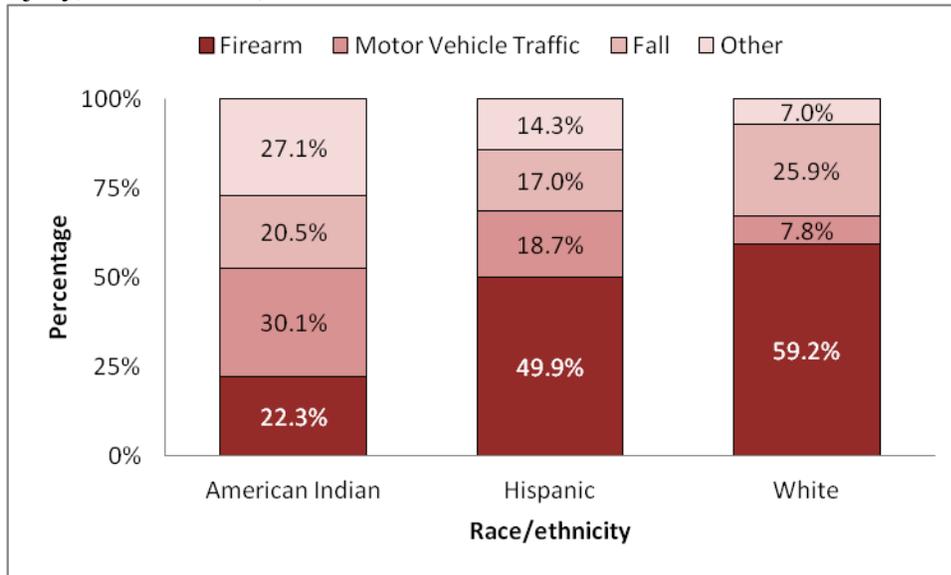
Over half of the TBI-related deaths among males during 2007-2011 were caused by firearms. Fall-related injury was the leading cause of TBI-related death among females.

Figure 11. Average annual traumatic brain injury death rates by gender and external cause of injury, New Mexico, 2007-2011



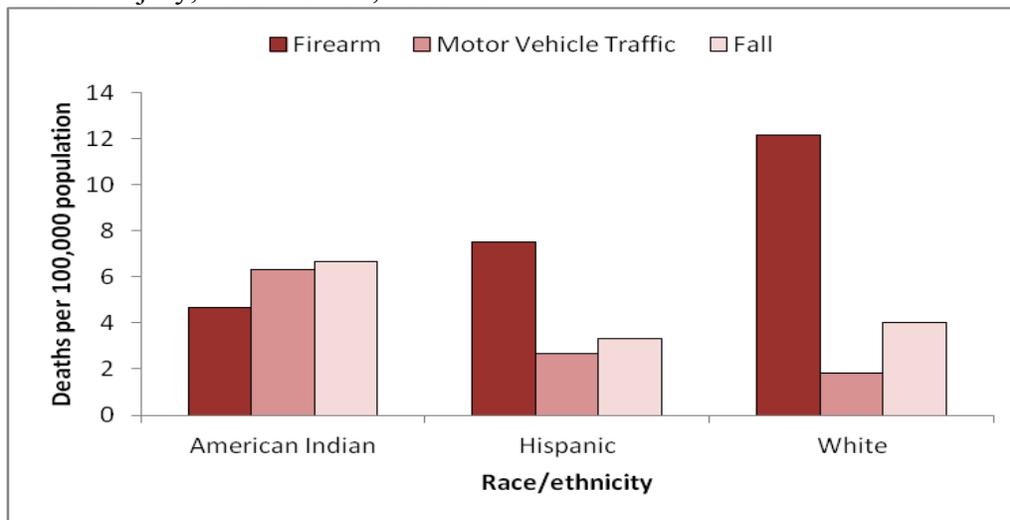
The firearm-related TBI death rate among males was 6.7 times higher than the rate among females.

Figure 12. Percentage of traumatic brain injury deaths by race/ethnicity and external cause of injury, New Mexico, 2007-2011



During 2007-2011 firearm-related injury was the leading cause of TBI death among whites and Hispanics. Motor vehicle traffic injury was the leading cause of TBI death among American Indians. Firearm-related injury accounted for 55% of TBI-related death among blacks.

Figure 13. Average annual traumatic brain injury death rates* by race/ethnicity and external cause of injury, New Mexico, 2007-2011



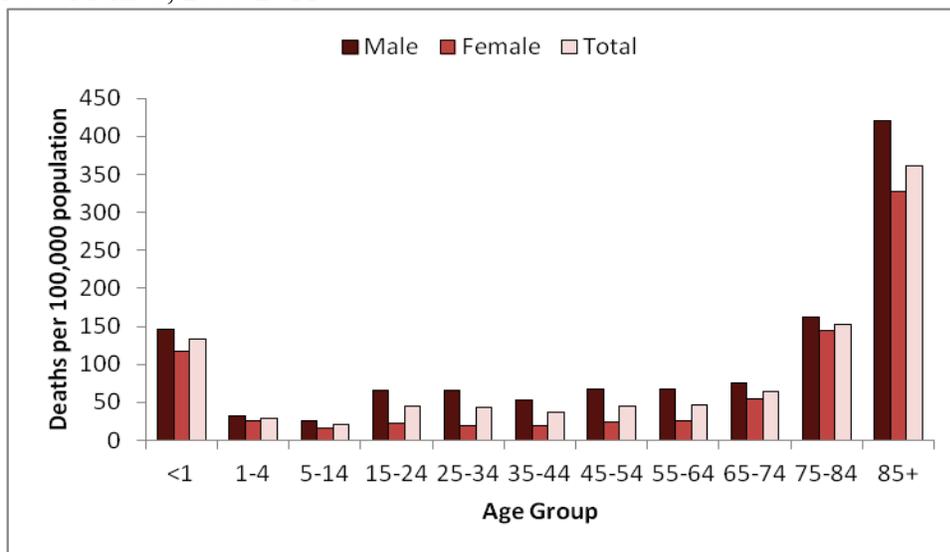
Age-adjusted to the 2000 Standard US population

Whites had the highest firearm-related TBI death rate, which was 2.6 times higher than the American Indian rate. American Indians had the highest motor vehicle traffic-related TBI death rate. The motor vehicle traffic-related TBI death rate declined 54% among the white population, declined 21% among the Hispanic population and increased 10% among American Indians during 2007-2011. American Indians had the highest fall-related TBI death rate. The fall-related TBI death rate decreased 8% among the white population from 2007-2011.

TBI-Related Hospitalizations

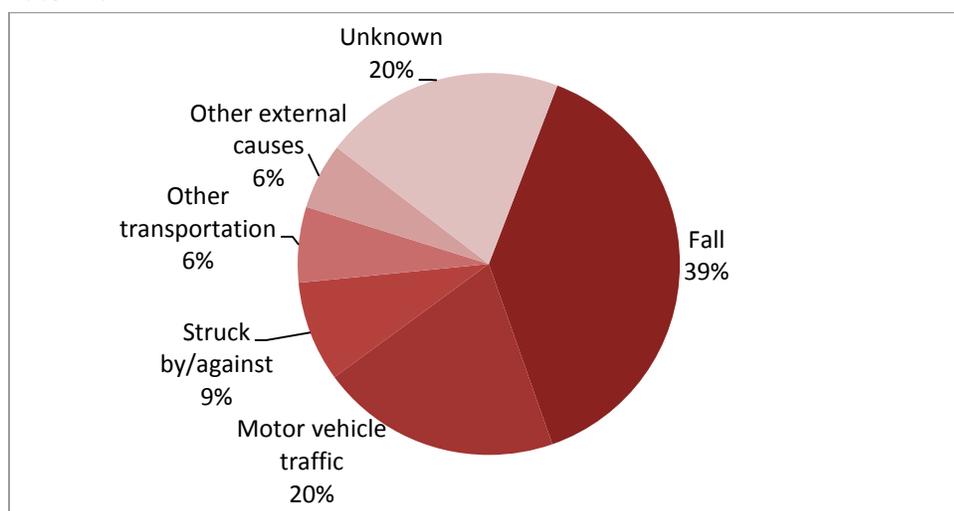
During 2009-2011, an annual average of 1,066 TBI hospitalizations occurred among NM residents.

Figure 14. Average annual traumatic brain injury hospital discharge rates, by age and gender, New Mexico, 2009-2011



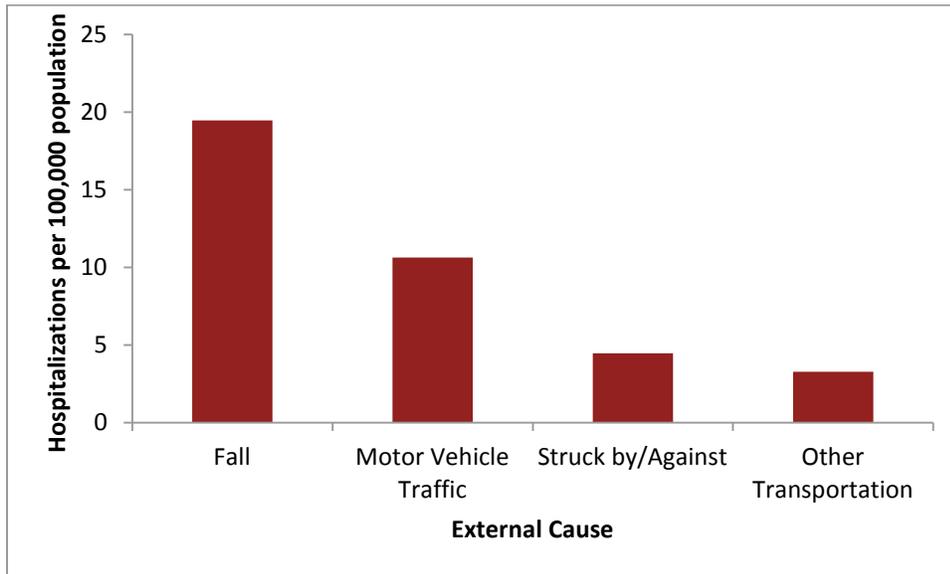
The TBI hospital discharge rate during 2009-2011 was highest among persons 85+ years of age. The TBI hospital discharge rate among males was two times higher than the rate among females.

Figure 15. Traumatic brain injury hospital discharges by external cause of injury, New Mexico, 2009-2011



Fall-related injury was the leading cause of TBI hospitalization during 2009-2011. The “Unknown” category includes missing E-codes and E-codes designating place of occurrence, injuries sustained during medical/surgical care and procedures, adverse effects of drugs, perpetrator of child and adult abuse and unspecified cause of injury.

Figure 16. Traumatic brain injury hospital discharge rate* by external cause of injury, New Mexico, 2009-2011



*Age-adjusted to the 2000 Standard US population

The fall-related TBI hospital discharge rate was almost twice as high as the motor-vehicle traffic-related TBI hospital discharge rate.

Figure 17. Average annual fall-related traumatic brain injury hospital discharge rates by age group, New Mexico, 2009-2011

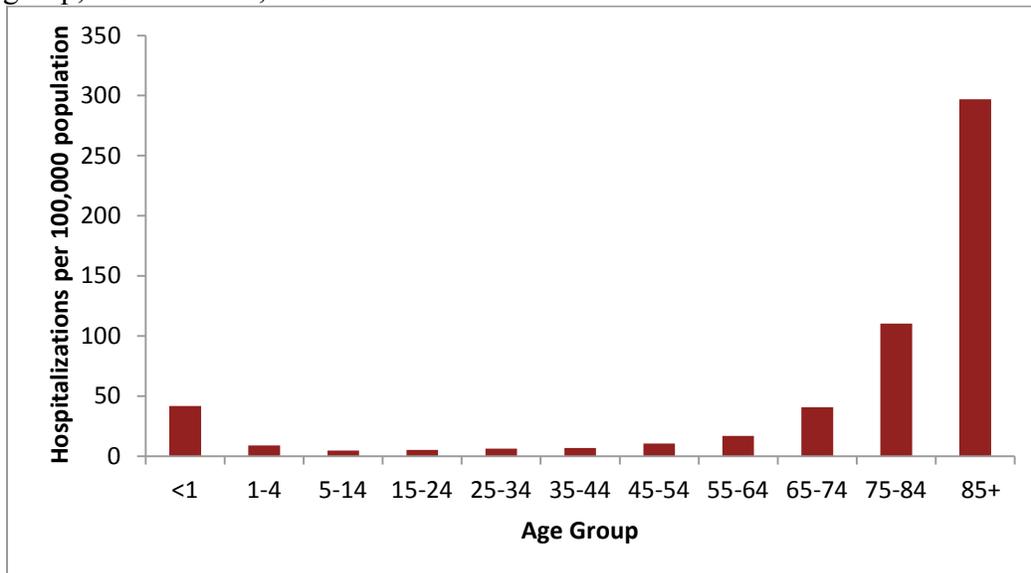
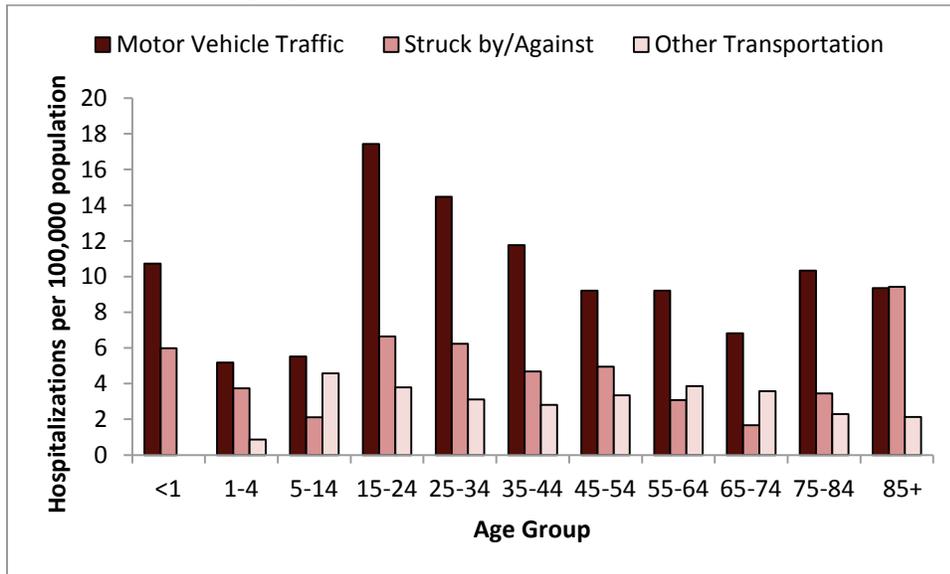


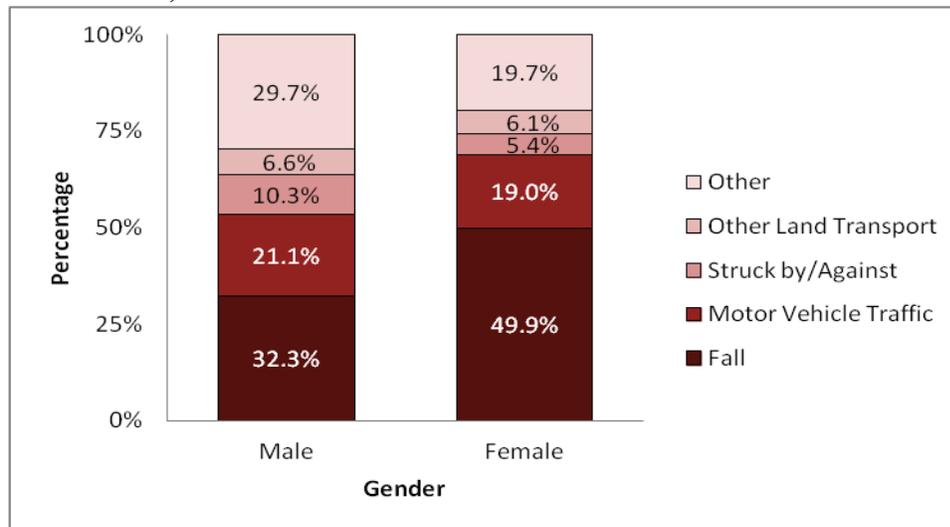
Figure 18 contains the rates by age group for the other leading causes of TBI hospitalizations.

Figure 18. Average annual traumatic brain injury hospital discharge rates by age group and external cause of injury, New Mexico, 2009-2011



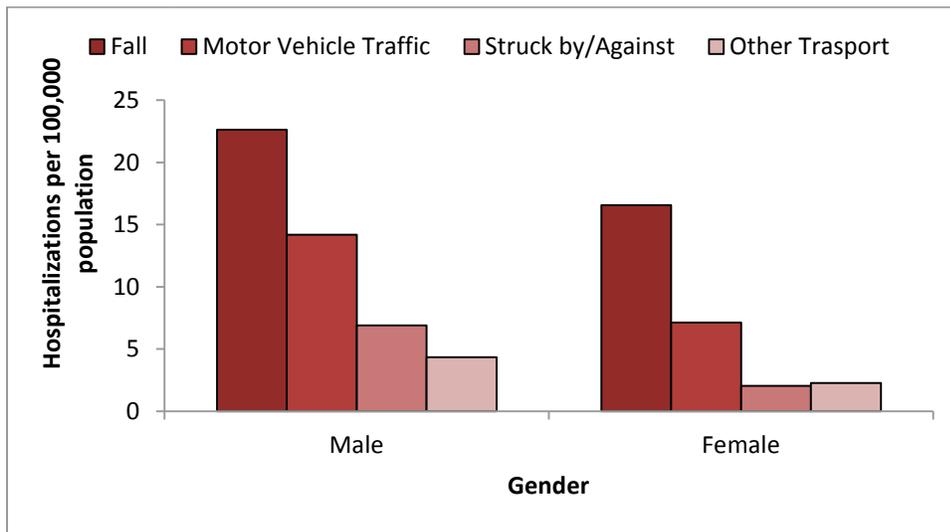
Older adults 85+ years of age had the highest fall-related TBI hospital discharge rate, followed by 75-84 year olds and children less than one year of age (Figure 17). Fall-related injury was the leading cause of TBI-related hospitalizations among 0-4 year olds and 45+ year olds. The motor vehicle traffic-related TBI hospital discharge rate was highest among 15-24 year olds, followed by 25-34 year olds and 35-44 year olds. Older adults 85+ years of age had the highest struck by, or against-related TBI hospital discharge rate and 5-14 year olds had the highest other land transport-related TBI hospital discharge rate.

Figure 19. Percentage of traumatic brain injury hospitalizations by gender and external cause, New Mexico, 2009-2011



Falls were the leading cause of TBI-related hospitalizations for both males and females. Fall-related injury was the cause of half of the TBI-related hospitalizations among females.

Figure 20. Traumatic brain injury hospital discharge rates by gender and external cause of injury, New Mexico, 2009-2011

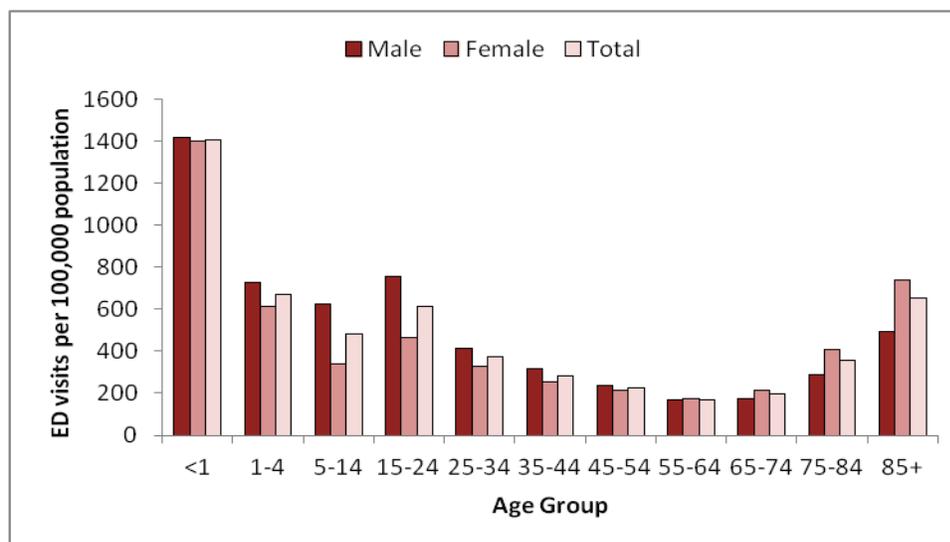


The motor vehicle traffic-related TBI hospitalization rate was two times higher among males than among females. The stuck by, or against-related TBI hospitalization rate was three times higher among males than among females.

TBI-Related Emergency Department Visits

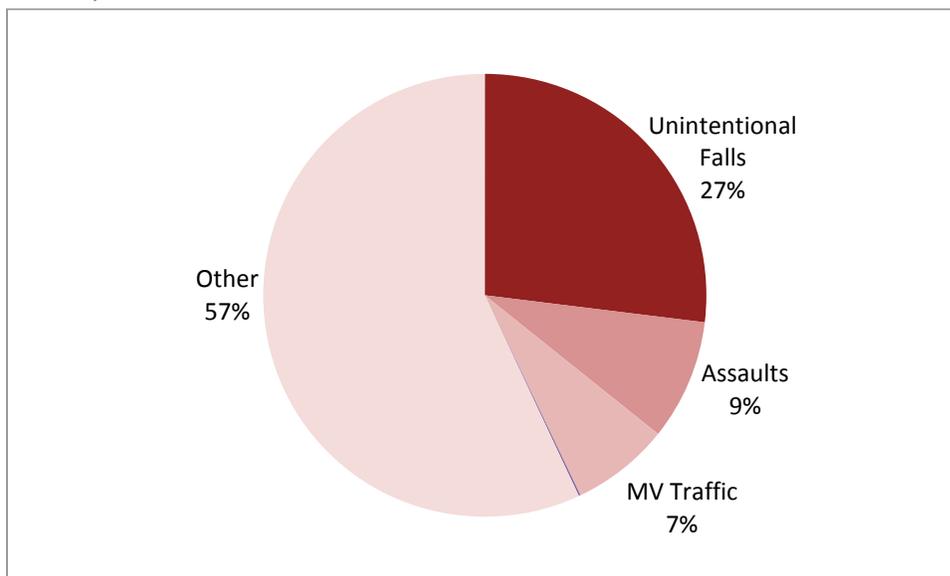
In 2010 7,991 emergency department visits for TBI occurred among NM residents.

Figure 21. Traumatic brain injury emergency department visit rates by age and gender, New Mexico, 2010



The 2010 TBI-related ED visit rate was 1.3 times higher for males than for females. Males accounted for 56% of the TBI-related ED visits during 2010. Infants had the highest TBI-related ED visit rate in 2010.

Figure 22. Traumatic brain injury emergency department visits by external cause of injury, New Mexico, 2010



Unintentional fall-related injury was the leading cause of injury requiring a visit to the emergency department in 2010. The external cause of injury was unknown for almost half of the injury-related emergency department visits in 2010. Nationally, fall-related injury was the leading cause of injury resulting in an emergency department visit for all ages and for each age group except 15-24 year olds. Struck by, or against was the leading cause of injury resulting in an emergency department visit among 15 to 24 year olds.

Prevention

Nationally, the leading causes of TBI (deaths, hospitalizations, emergency department visits, etc.) from 2002-2006 were falls (35.2%), motor vehicle traffic (17.3%), struck by, or against an object (16.5%) and assault (10.0%). The leading causes of TBI-related death in NM during 2007-2011 were firearms, falls and motor vehicle traffic-related injuries. The leading causes of hospitalizations in NM during 2009-2011 were falls, motor vehicle traffic-related injuries, struck by, or against an object and other land transport such as all terrain vehicle crashes.

State agencies and organizations in New Mexico are engaged in several activities to prevent injuries that result in a TBI. The Office of Injury Prevention (OIP), an office within the Epidemiology and Response Division of the New Mexico Department of Health coordinates the statewide New Mexico Adult Falls Prevention Coalition. The Coalition follows the “Falls Free: National Action Plan” which has identified the following prevention focus areas to prevent falls: home safety, physical activity, medication safety, and environmental safety in the community. The OIP has brought two evidence-based programs to NM, which are Tai Chi: Moving for Better Balance training and Fear of Falling: A Matter of Balance program. Participants have been trained to provide instruction on the Tai Chi program in 24 communities throughout the state. The Fear of Falling: A Matter of Balance program continues to be implemented in communities throughout the state. The OIP co-facilitates the Healthy Aging Collaborative with the Aging and

Long Term Services Department. The collaborative has brought the national Osteoporosis Foundation to New Mexico to train participants on advocacy. The OIP participates on the Arthritis Advisory Council and shares its resources to support the Chronic Disease Self Management program.

Motor vehicle traffic deaths in NM have decreased sharply since 2007. The poor economy resulting in changes in driving habits, including driving at a slower speed and driving less often, could be a contributing factor in the recent sharp decline in the motor vehicle traffic death rate. Conversely, however, the motorcycle death rate increased 100% from 1999 through 2009. NM has a primary enforcement seat belt law but only a partial helmet law for motorcycle riders, which requires people 17 years of age and younger to wear a helmet while riding a motorcycle. Sobriety check points are conducted by law enforcement agencies to reduce drinking and driving. NM implemented the ignition interlock law in June 2005 to prevent a person who has been convicted of DWI from starting a vehicle. NM implemented the Graduated Driver's License (GDL) program for teens under the age of 18 in January 2000. GDL requires anyone under the age of 18 applying for a learner's permit to complete a three-stage process to obtain a driver's license. The provisional license under stage 2 places restrictions on the number of passengers allowed and night time driving.

The motor vehicle traffic death rate among American Indians is higher than the rate among non-American Indians. Culturally appropriate interventions to increase child safety seat and seat belt use and to reduce alcohol-impaired driving should be tailored to meet the specific needs of the tribes.

The 2006 Revised Fee and Safety Requirements for Off Road Vehicles added mandatory helmet use for all minors, as well as other safety requirements, for anyone under the age of 18 driving or riding on an all terrain vehicle, miniature or "pocket" motorcycle or snowmobile. To help reduce the number of traumatic brain injuries in children that are associated with non-motorized vehicles, the 2007 New Mexico Legislature passed the most comprehensive helmet law for children and youth in the nation. The 2007 Child Helmet Safety Act requires that all children younger than 18 years wear helmets when riding bicycles, tricycles, skateboards, scooters, and skates on public property. The combined requirements of both laws has made New Mexico the only state to require that every minor under age 18 wear a helmet on every vehicle, motorized or non-motorized, unless it has seat belts and accommodation for car seats.

Struck by, or against an object, is the third leading cause of TBI-related hospitalization in NM. NM passed a "return to play" law in 2010 to protect young athletes from deadly or disabling consequences of returning to play too soon after a TBI. The law requires that safety protocols for brain injury during school athletic activity be provided to coaches and parents of student athletes. A student athlete who exhibits signs of head injury is to be held out of activity until he or she no longer exhibits any associated symptoms and is cleared by a medical professional.

Firearm injury is the leading cause of TBI death in NM and most of the firearm injuries are due to suicide. The New Mexico Suicide Prevention Coalition is engaged in suicide prevention and intervention activities, and provides education, support and advocacy to reduce the suicide rate in New Mexico. Substance abuse and mental health disorders are the two most common psychiatric disorders associated with suicide. Preventing suicide involves recognizing signs that

someone is at risk of committing suicide and responding to those signs by helping the person obtain treatment of depression and other psychiatric illnesses.

Recommendations

Helmets should be worn when riding a motorcycle and engaging in contact sports, such as football, as well as baseball and softball. Other outdoor activities in which helmets should be worn include skiing, snowboarding, ice skating and horseback riding. Parents should also constantly remind children and youth under age 18 that wearing a helmet while riding a bicycle, tricycle, skateboard and scooter, as well as an all terrain vehicle, motorcycle, miniature motorcycle or snowmobile, is required by New Mexico state law.

Seniors should have a clinical assessment for falls at every primary health care visit. They should also participate in community-sponsored programs, such as Tai Chi, which are designed to reduce falls through improving gait and balance. A home safety fall assessment should be conducted for all seniors. Tripping hazards, including loose rugs and clutter in walkways should be removed. Other ways to make living spaces safer include installing non-slip mats and grab bars in tubs and showers and improving lighting in the home. Fall hazards outside the home should also be addressed. Large cracks in sidewalks and driveways should be repaired. Sidewalks and driveways should be kept free of ice and rocks. Adequate lighting should be installed by doorways and along walkways leading to doors. Medications should be reviewed by a pharmacist or other health care professional, since some drugs can cause dizziness. Seniors should also have annual eye exams.

Access to firearms is associated with an increased risk of suicide. About 85% of suicide attempts using a firearm are fatal. To reduce access to firearms, firearms should be stored unloaded in a locked box.

References

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3. Zaloshnja E. et al., Prevalence of long-term disability from traumatic brain injury in the civilian population of the United States, 2005. *J Head Trauma Rehab* 2008;23:394-400.
4. Selassie AW, et al., Incidence of long-term disability following traumatic brain injury hospitalization, United States, 2003. *J Head Trauma Rehab* 2008;23:123-31.
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Appendix

The following ICD-10 nature-of-injury codes were used to identify TBI deaths:

S01.0-S01.9 – Open wound of the head
S02.0, S02.1, S02.3, S02.7-S02.9 – Fracture of skull and facial bones
S04.0 – Injury to optic nerve and pathways
S06.0-S06.9 – Intracranial injury
S07.0, S07.1, S07.8, S07.9 – Crushing injury of head
S09.7-S09.0 – Other and unspecified head injuries
T01.0 – Open wounds involving head with neck
T02.0 – Fractures involving head with neck
T04.0 – Crushing injuries involving head with neck
T06.0 – Injuries of brain and cranial nerves with injuries of nerves and spinal cord at neck level
T90.1, T90.2, T90.4, T90.5, T90.8, T90.9 – Sequelae of injuries of head

The following ICD-9-CM nature-of-injury codes were used to identify TBI hospitalizations:

800-800.99 – Fracture of vault of skull
801-801.99 – Fracture of base of skull
803-803.99 – Other and unqualified skull fractures
804-804.99 – Multiple fractures involving skull or face with bones
850-850.9 – Concussion
851-851.99 – Cerebral laceration and contusion
852.0-852.59 – Subarachnoid, subdural, and extradural hemorrhage, following injury
853.0-853.19 – Other and unspecified intracranial hemorrhage following injury
854.0-854.19 – Intracranial injury of other unspecified nature
959.01 – Head injury, unspecified
995.55 – Shaken infant syndrome