

Traumatic Brain Injuries Among Arizona Residents, 2008

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Prepared by: Alana Shacter, MPH
150 North 18th Avenue, Suite 320
Phoenix, AZ 85007
Injury Prevention Program
Bureau of Women's and Children's Health
Arizona Department of Health Services
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Executive Summary

Traumatic brain injuries were the cause of death for 1,325 Arizona residents in 2008. Males ages 85 years and older had the highest rate of TBI deaths with 174.5 deaths per 100,000 residents. TBI death rates were highest among American Indians (30.5 per 100,000 residents) and Non-Hispanic Whites (19.5 per 100,000 residents). Fifty-one percent of TBI deaths in 2008 were due to unintentional injuries (n=667); 35 percent were due to suicides (n=466); and 11 percent were due to homicides (n=147). The most common causes of TBI deaths of any intent were firearms (44 percent, n=585), falls (23 percent, n=304), and motor vehicle traffic-related injuries (20 percent, n=269).

In 2008, there were 4,949 inpatient hospitalizations due to TBI. Adults 85 years and older had the highest rates of TBI inpatient hospitalizations. Males 85 years and older had a rate of 315.1 per 100,000 residents. The rate for females 85 years and older was 358.5 per 100,000 residents. TBI inpatient hospitalization rates were highest among American Indians (121.7 per 100,000 residents) and Non-Hispanic Whites (77.5 per 100,000 residents). Unintentional injuries accounted for 86 percent of TBI hospitalizations (n=4,271) and assaults comprised an additional 12 percent (n=603). Motor vehicle traffic-related injuries were the most common cause of TBI hospitalizations (40 percent, n=1,956), followed by falls (33 percent, n=1,653).

In 2008, there were 35,755 TBI emergency department visits among Arizona residents. Almost half of TBI emergency department visits were among children ages 19 and younger (46 percent, n=16,297), as a result of physical and mental factors that make children and young adults more susceptible to TBIs and the injuries that may cause them. TBI emergency department visit rates were highest among children younger than one year of age. Females younger than one year of age had a rate of 1,747.1 visits per 100,000 residents, and males younger than one year of age had a rate of 1,956.8 visits per 100,000 residents. The majority of TBI emergency department visits were due to unintentional injuries (88 percent, n=31,207), and 12 percent were due to assaults (n=4,371). The leading causes of TBI emergency department visits were falls (48 percent, n=17,258), struck by/against injuries (24 percent, n=8,624), and motor vehicle traffic-related injuries (14 percent, n=4,959).

The data presented in this report show that TBI is a public health problem that impacts the lives of thousands of Arizona residents each year. The effects of TBI can include chronic pain, disability, large medical bills, changes in quality of life, and premature death. TBI can occur throughout the life span, and the repercussions of these injuries may be experienced for many years. The consequences of TBI can extend beyond the injured individuals to their families and communities. With non-fatal TBI, family members are often required to provide care, which can result in time away from work, loss of income, and increases in stress. Within a community, the financial costs of TBI include medical expenses, rehabilitation, lost wages, and lost productivity. **Most TBI injuries are predictable and preventable.** Understanding the causes of TBI is an important step towards educating and empowering communities and implementing effective prevention strategies.

Introduction

Traumatic brain injury (TBI) is defined as damage to the brain following a sudden blow to the head or by shaking the head violently. TBI can also be caused by a penetrating head injury that disrupts brain function. An estimated 1.4 million Americans sustain these injuries each year, and of these, 50,000 die as a result of the trauma.¹ An additional 80,000 to 90,000 experience permanent disability, and it is estimated that 5.3 million Americans are currently living with a TBI-related disability.^{2,3} TBI can cause cognitive function deficits, which can lead to depression and other secondary outcomes including problems working and performing daily activities such as completing homework, managing personal finances, or driving a vehicle.

Figure 1. Traumatic Brain Injury Pyramid, Arizona 2008

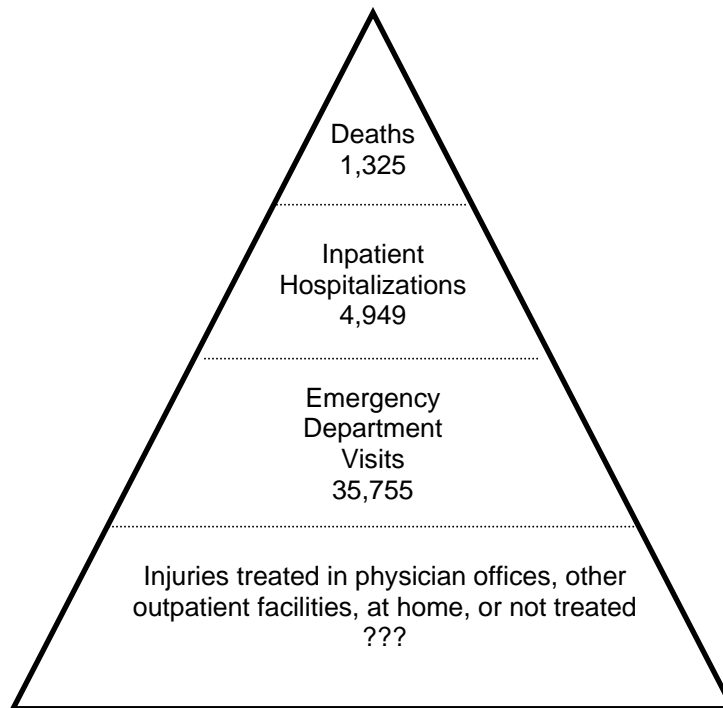


Figure 1 shows a TBI pyramid for Arizona in 2008. This pyramid shows that deaths represent the smallest proportion of injuries. The proportions increase towards the foundation of the pyramid, which is comprised of hospital discharges, emergency department visits, and self-care. Although TBI that do not require medical treatment may be the most numerous, no existing datasets capture these types of injuries.

¹ Langlois JA, Rutland-Brown W, Thomas KE. *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations and Deaths*. Atlanta (GA): Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2006

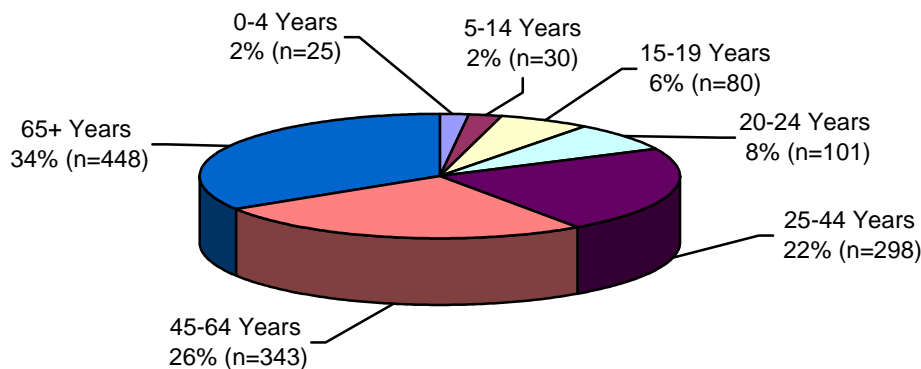
² Ibid

³ Thurman D, Alverson C, Dunn K, Guerrero J, Sniezek J. Traumatic brain injury in the United States: a public health perspective. *Journal of Head Trauma Rehabilitation* 1999;14(6):602–15.

Deaths

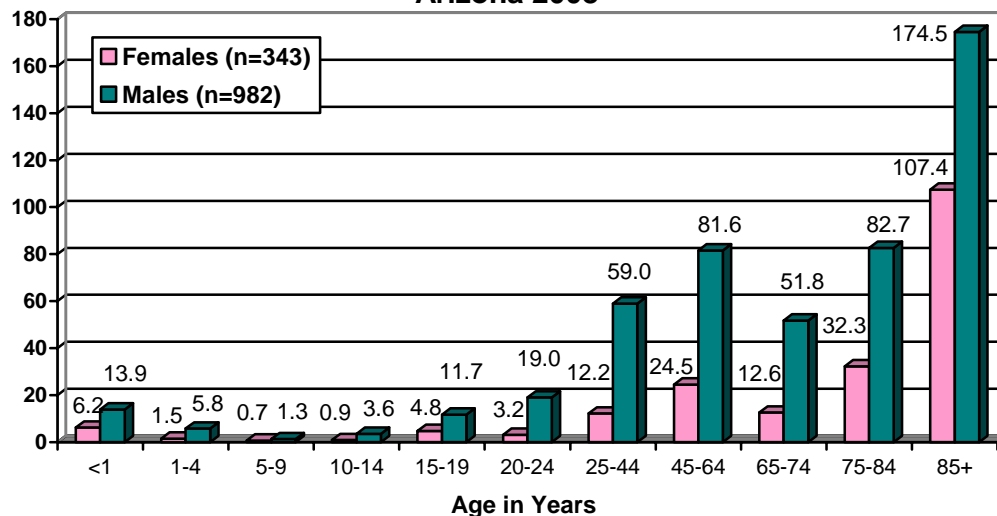
In 2008, 1,325 Arizona residents died as a result of TBI. The majority of deaths were among males (74 percent, n=982), while females accounted for 26 percent of TBI deaths (n=343). The largest percentage of deaths was among individuals ages 65 years and older (34 percent, n=448). Children ages 19 and younger accounted for 10 percent of TBI deaths in 2008 (n=135). Age distributions are shown in Figure 2.

**Figure 2. TBI Deaths by Age Group, Arizona 2008
(n=1,325)**



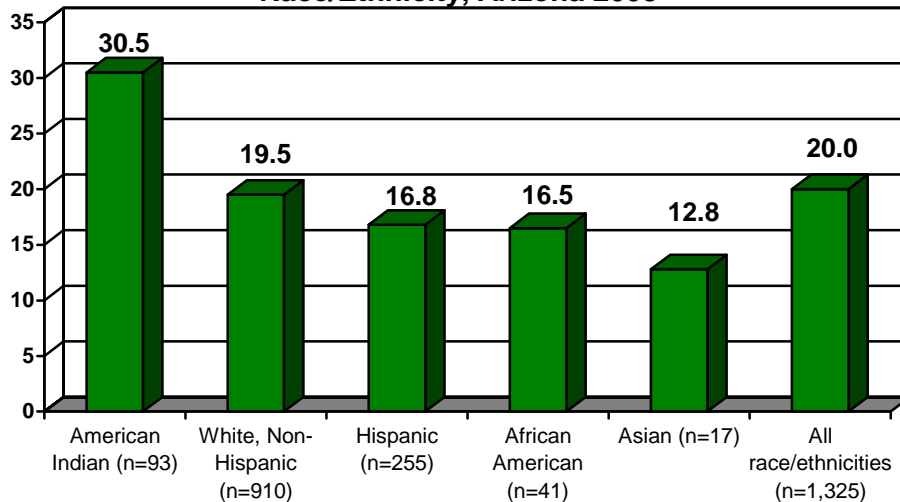
Males 85 years and older accounted for 72 deaths and had the highest rate of TBI deaths in 2008 (174.5 per 100,000 residents). For all adults 85 years and older, 72 percent of TBI deaths were due to unintentional falls (n=105). Figure 3 shows the 2008 TBI death rates by age group and sex for Arizona residents.

Figure 3. TBI Mortality Rates per 100,000 by Age Group and Sex, Arizona 2008



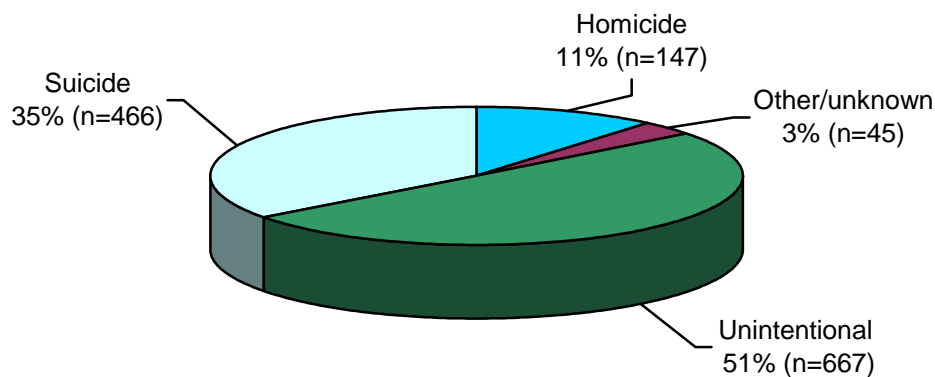
TBI death rates were highest among American Indians (30.5 per 100,000 residents) and Non-Hispanic Whites (19.5 per 100,000 residents). Figure 4 shows the 2008 age-adjusted TBI death rates by race/ethnicity in Arizona.

Figure 4. Age-Adjusted TBI Mortality Rates per 100,000 by Race/Ethnicity, Arizona 2008



Half of the TBI deaths in 2008 were due to unintentional injuries (51 percent, n=667); 35 percent were due to suicides (n=466); and 11 percent were due to homicides (n=147). Figure 5 shows TBI deaths by intent during 2008 in Arizona.

Figure 5. TBI Deaths by Intent, Arizona 2008 (n=1,325)



The most common causes of deaths were firearms (44 percent, n=585), falls (23 percent, n=304), and motor vehicle traffic-related injuries (20 percent, n=269). Causes of TBI deaths during 2008 in Arizona are shown in Table 1. Descriptions of these causes are given in Appendix A.

Table 1. TBI Deaths by Cause, Arizona 2008		
Cause	Number	Percentage
Firearm	585	44%
Fall	304	23%
Motor vehicle traffic	269	20%
Other/unspecified	122	9%
Other land transport	25	2%
Unknown cause	20	2%
Total	1,325	100%

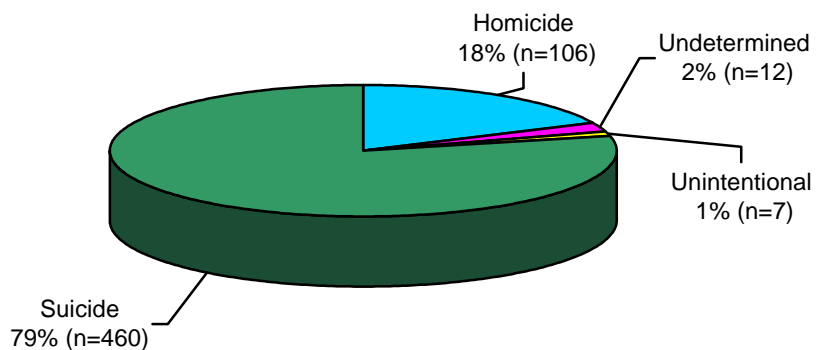
Firearm-Related TBI Mortality

Among the 585 Arizona residents who died as a result of firearm-related TBI, the majority were male (83 percent, n=484) and 17 percent were female (n=101). Nine percent of TBI deaths due to firearms were among children 19 years and younger (n=50). Nine percent of the deaths were among individuals ages 20 to 24 years (n=54); 61 percent were among individuals ages 25 to 64 years (n=358); and 21 percent were among individuals 65 years and older (n=123).

The highest rate of firearm-related TBI deaths was among White Non-Hispanics (n=434). This population had a rate of 9.7 deaths per 100,000 residents. The second highest rate was among African Americans, who accounted for 21 deaths, or 7.7 per 100,000 residents.

The majority of firearm-related TBI deaths were suicides (79 percent, n=460). Eighteen percent of the deaths were due to homicides (n=106); two percent were of undetermined intent (n=12); and one percent were due to unintentional injuries (n=7). Figure 6 shows TBI deaths due to firearms by intent.

Figure 6. TBI Deaths due to Firearms by Intent, Arizona 2008 (n=585)



Fall-Related TBI Mortality

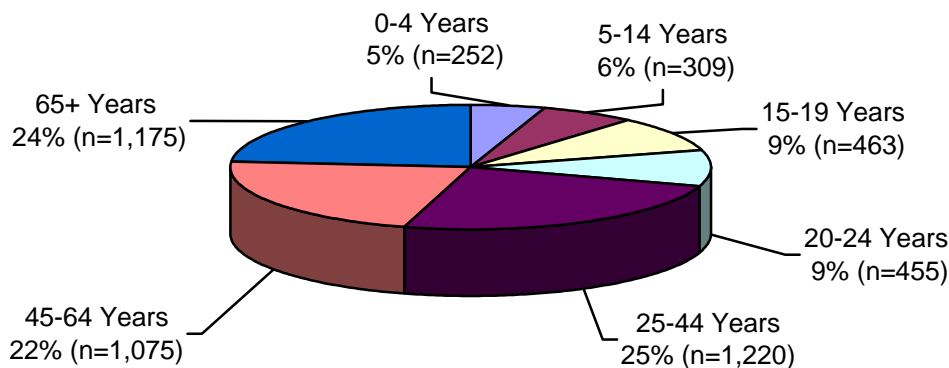
Of the 304 TBI deaths due to falls, 57 percent were among males (n=174) and 43 percent were among females (n=130). All but three of the falls were unintentional. Three percent of TBI deaths due to falls were among children and young adults ages 24 years and younger (n=9). Sixteen percent of the deaths were among adults ages 25 to 64 years (n=49); and 81 percent were among adults 65 years and older (n=246).

The highest rate of fall-related TBI deaths was among American Indians (7.7 per 100,000 residents; n=16). The second highest rate was among Asians, who accounted for four deaths, or 5.0 per 100,000 residents. The age-adjusted mortality rate for fall-related TBI deaths among all races/ethnicities was 4.4 deaths per 100,000 residents.

Non-Fatal Inpatient Hospitalizations

In 2008, 4,949 Arizona residents were hospitalized due to TBI. Males comprised 65 percent of total TBI hospitalizations (n=3,230) and females accounted for 35 percent (n=1,718). One hospitalization was of an individual of unknown sex. Twenty percent of TBI inpatient hospitalizations were among children ages 19 years and younger (n=1,024). The age distribution is shown in Figure 7.

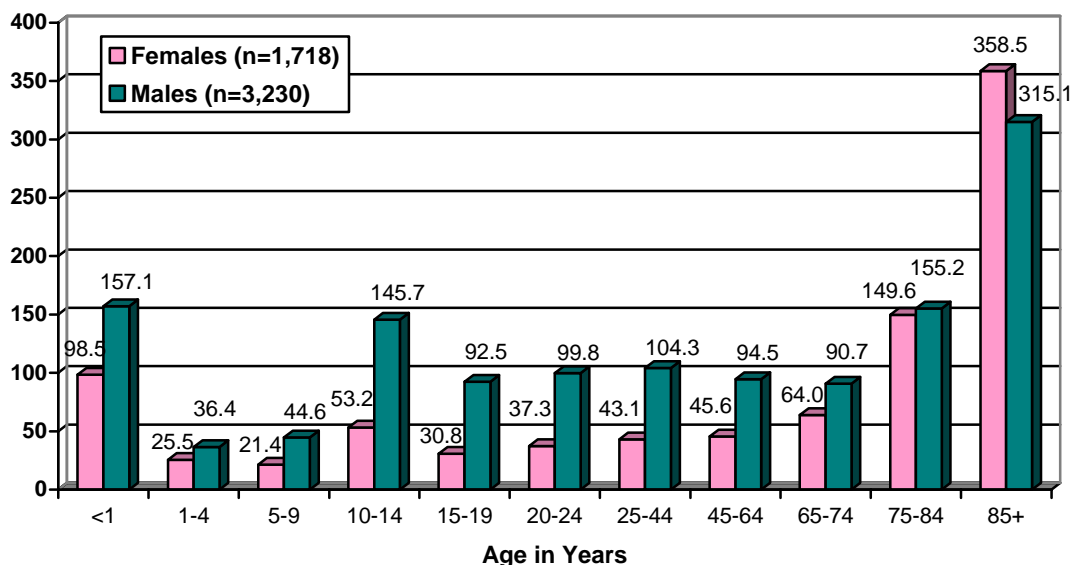
Figure 7. TBI Inpatient Hospitalizations by Age Group, Arizona 2008 (n=4,949)



Adults 85 years and older had the highest rates of TBI inpatient hospitalizations in 2008. Males 85 years and older had a rate of 315.1 per 100,000 residents (n=130), and the rate for females 85 years and older was 358.5 per 100,000 residents (n=247). For adults 85 years and older, 90 percent of hospitalizations were due to unintentional falls (n=339).

In contrast to the pattern observed with TBI deaths, the highest rates of TBI hospitalizations among children were among infants younger than one year of age. For infants younger than one year, 58 percent of hospitalizations were due to unintentional falls (n=74). Figure 8 shows the 2008 TBI inpatient hospitalization rates by age group and sex for Arizona residents.

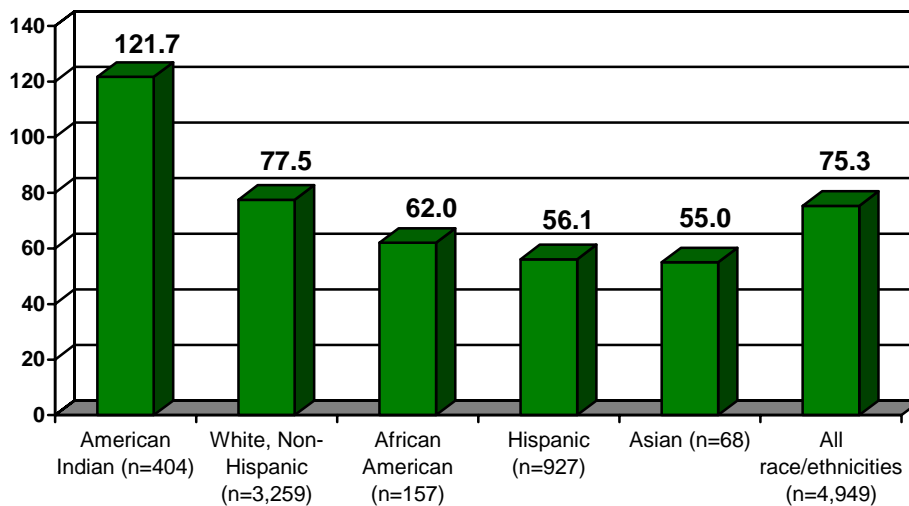
Figure 8. TBI Inpatient Hospitalization Rates per 100,000 by Age Group and Sex, Arizona 2008



Does not include one individual of unknown sex

TBI inpatient hospitalization rates were highest among American Indians (121.7 per 100,000 residents) and Non-Hispanic Whites (77.5 per 100,000 residents). Figure 9 shows the 2008 age-adjusted TBI inpatient hospitalization rates by race/ethnicity in Arizona.

Figure 9. Age-Adjusted TBI Inpatient Hospitalizations Rates per 100,000 by Race/Ethnicity, Arizona 2008

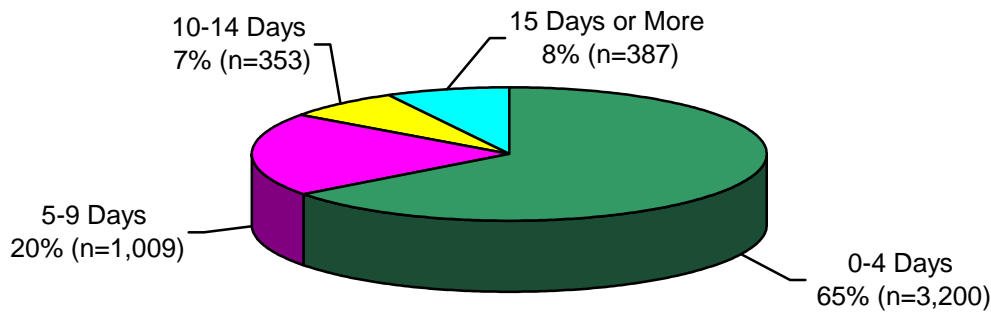


134 hospitalizations were other or unknown race/ethnicity

For TBI inpatient hospitalizations, the average length of stay was five days, with the majority of stays less than five days (65 percent, n=3,200). Length of stay in hospitals

due to TBI ranged from less than one full day to 81 days. Figure 10 shows TBI inpatient hospitalizations by length of stay.

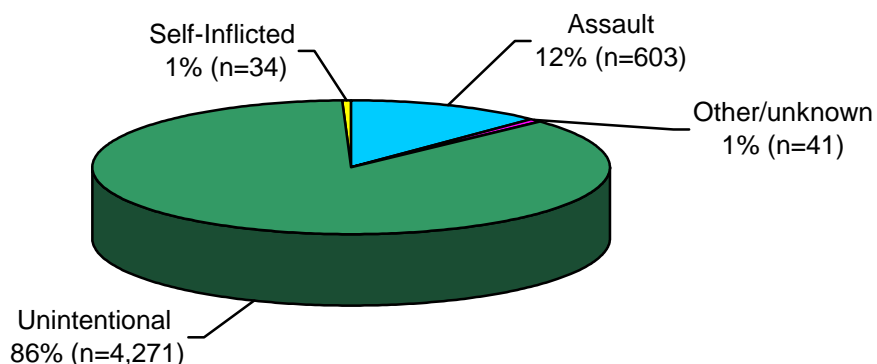
Figure 10. TBI Inpatient Hospitalizations by Length of Stay, Arizona 2008 (n=4,949)



TBI inpatient hospitalization charges in 2008 totaled more than \$314 million, with 48 percent paid by the Arizona Health Care Cost Containment System (AHCCCS)/Medicaid and Medicare. This total does not include costs related to physician care, rehabilitation, lost wages, or long-term costs of disability.

Unintentional injuries accounted for 86 percent of TBI hospitalizations (n=4,271). There were 34 self-inflicted TBI hospitalizations (one percent) and 603 assaults (12 percent). Figure 11 shows the TBI inpatient hospitalizations by intent for Arizona in 2008.

Figure 11. TBI Inpatient Hospitalizations by Intent, Arizona 2008 (n=4,949)



Motor vehicle traffic-related injuries were the most common cause of TBI hospitalizations (40 percent, n=1,956), followed by falls (33 percent, n=1,653). Table 2 shows causes of TBI inpatient hospitalizations in Arizona during 2008. Descriptions of these causes are given in Appendix A.

Cause	Number	Percentage
Motor vehicle traffic	1,956	40%
Fall	1,653	33%
Struck by/against	507	10%
Other/unspecified	351	7%
Transport	313	6%
Other pedal cycle	87	2%
Firearm	50	1%
Cut/pierce	32	1%
Total	4,949	100%

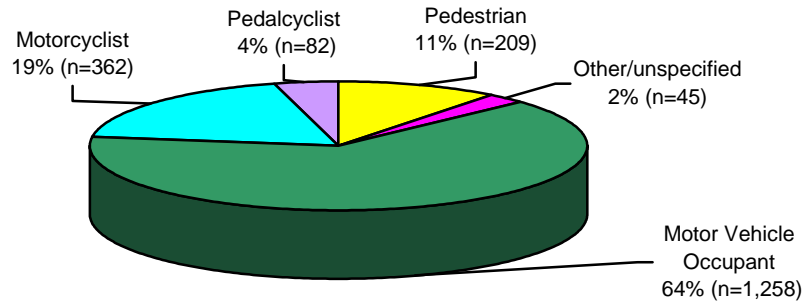
Non-Fatal Motor Vehicle Traffic Crash-Related TBI Inpatient Hospitalizations

Of the 1,956 TBI hospitalizations due to motor vehicle traffic crashes, 64 percent were among males (n=1,258) and 36 percent were among females (n=698). Almost all of the crashes were unintentional (n=1,952). Twenty-two percent of TBI hospitalizations due to motor vehicle traffic crashes were among children 19 years and younger (n=425); 13 percent were among individuals ages 20 to 24 years (n=256); 56 percent were among individuals 25 to 64 years (n=1,089); and 10 percent were among adults 65 years and older (n=186).

American Indians had the highest rate of TBI hospitalizations for motor vehicle traffic crashes (45.1 per 100,000 residents; n=157). With 32.9 hospitalizations per 100,000 residents, Non-Hispanic Whites had the second highest rate (n=1,279).

The majority of TBI inpatient hospitalizations due to motor vehicle traffic collisions were among occupants of motor vehicles (64 percent, n=1,258). Nineteen percent were motorcyclists (n=362); 11 percent were pedestrians (n=209); and four percent were pedal cyclists (n=82). Two percent were other/unspecified (n=45). Figure 12 shows TBI inpatient hospitalizations due to motor vehicle traffic crashes by injured person.

Figure 12. TBI Inpatient Hospitalizations due to Motor Vehicle Traffic Crashes by Injured Person (All Intents), Arizona 2008 (n=1,956)



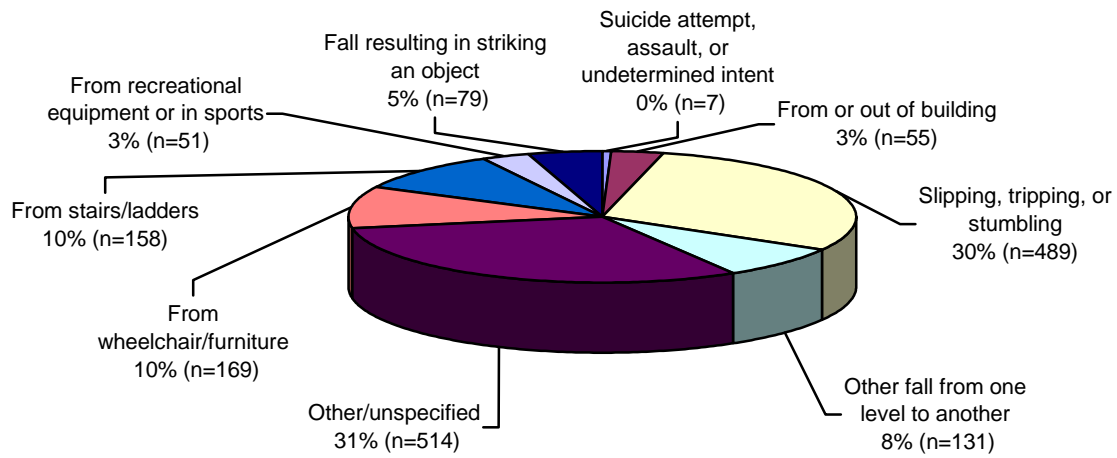
Non-Fatal Fall-Related TBI Inpatient Hospitalizations

There were 1,653 inpatient hospitalizations due to fall-related TBI. Fifty-five percent were among males (n=912) and 45 percent were among females (n=741). Sixteen percent of the hospitalizations were among children 19 years and younger (n=258). Almost all of these falls were unintentional (n=1,646), but seven were self-inflicted or from assaults or undetermined intents.

Asians had the highest rate of fall-related TBI hospitalizations with 26.6 per 100,000 residents (n=27). The second highest rate was among Non-Hispanic Whites (24.9 per 100,000 residents; n=1,231).

In more than one quarter of fall-related hospitalizations, the hospital discharge database did not contain any specific information about the events contributing to these falls (25 percent, n=421). The most frequently specified contributing events were slipping, tripping, or stumbling (30 percent, n=489) and falls from wheelchairs, beds, or other furniture (10 percent, n=169). Figure 13 shows TBI inpatient hospitalizations due to falls by contributing event.

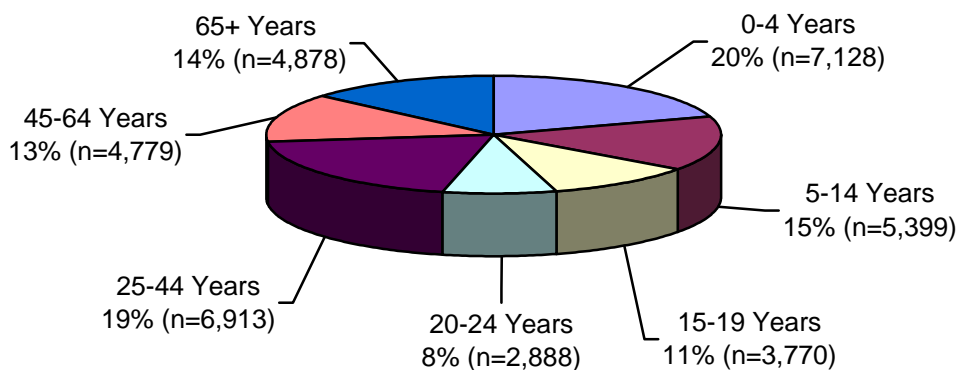
Figure 13. TBI Inpatient Hospitalizations due to Falls by Contributing Event (All Intents), Arizona 2008 (n=1,653)



Non-Fatal Emergency Department Visits

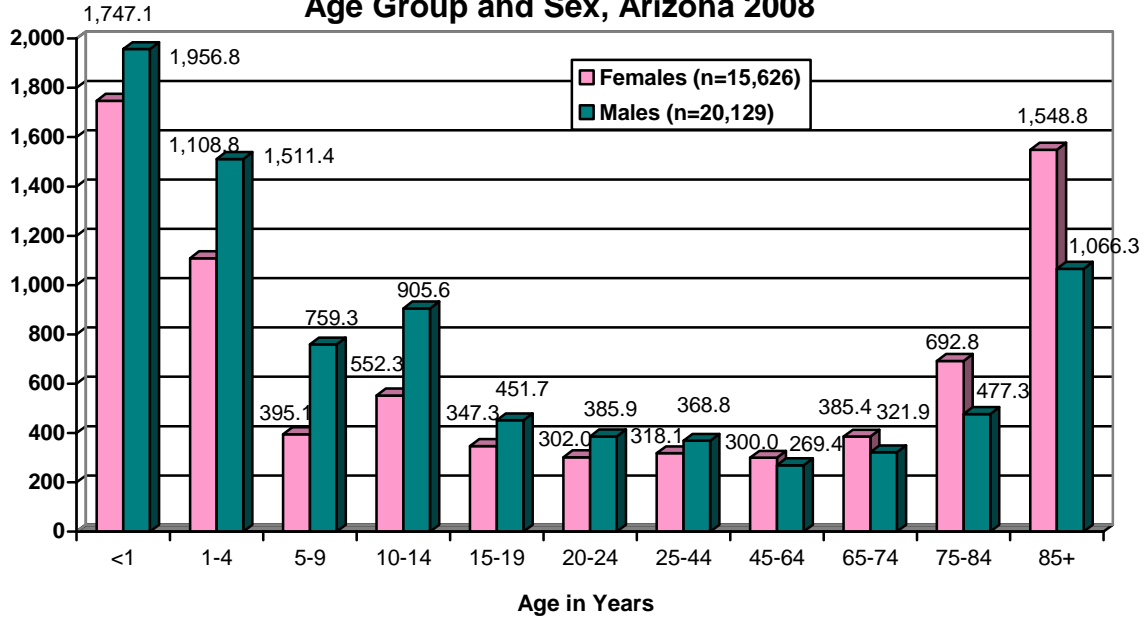
In 2008, there were 35,755 TBI emergency department visits among Arizona residents. Males accounted for more than half of TBI emergency department visits (56 percent, n=20,129), while females accounted for 44 percent of visits (n=15,626). Forty-six percent of TBI emergency department visits were among children ages 19 years and younger (n=16,297). Emergency department visits by age group are shown in Figure 14.

Figure 14. TBI Emergency Department Visits by Age Group, Arizona 2008 (n=35,755)



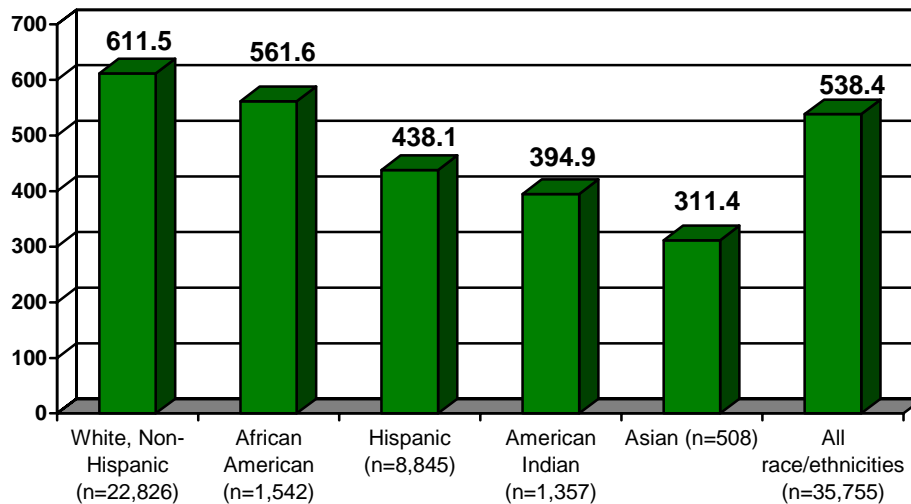
TBI emergency department visit rates were highest among children younger than one year of age. There were 851 emergency department visits among females younger than one year of age (a rate of 1,747.1 per 100,000 residents), and 984 visits among males younger than one year of age (a rate of 1,956.8 per 100,000 residents). For all children younger than one year of age, 86 percent of TBI emergency department visits were due to unintentional falls (n=1,569). For adults 85 years and older, 93 percent of visits were due to unintentional falls (n=1,407). Figure 15 shows the 2008 TBI emergency department visit rates per 100,000 Arizona residents.

Figure 15. TBI Emergency Department Visit Rates per 100,000 by Age Group and Sex, Arizona 2008



TBI emergency department visit rates were highest among Non-Hispanic Whites (611.5 per 100,000 residents) and African Americans (561.6 per 100,000 residents). Figure 16 shows the 2008 age-adjusted TBI emergency department visit rates by race/ethnicity in Arizona.

Figure 16. Age-Adjusted TBI Emergency Department Visit Rates per 100,000 by Race/Ethnicity, Arizona 2008



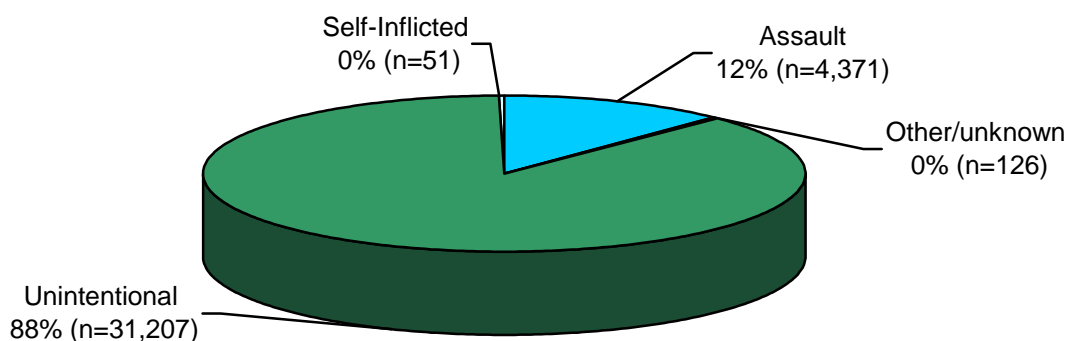
677 emergency department visits were by individuals of other or unknown race/ethnicity

TBI emergency department charges in 2008 totaled more than \$139 million, with 37 percent paid by the Arizona Health Care Cost Containment System

(AHCCCS)/Medicaid and Medicare. This total does not include costs related to physician care, rehabilitation, lost wages, or long-term costs of disability.

The majority of TBI emergency department visits were attributed to unintentional injuries (88 percent, n=31,207), and 12 percent were assaults (n=4,371). Figure 17 shows TBI emergency department visits by intent during 2008 in Arizona.

Figure 17. TBI Emergency Department Visits by Intent, Arizona 2008 (n=35,755)



The leading causes of TBI emergency department visits were falls (48 percent, n=17,258), struck by/against injuries (24 percent, n=8,624), and motor vehicle traffic-related injuries (14 percent, n=4,959). Table 3 shows TBI emergency department visits by cause for Arizona in 2008. Descriptions of these causes are given in Appendix A.

Cause	Number	Percentage
Fall	17,258	48%
Struck by/against	8,624	24%
Motor vehicle traffic	4,959	14%
Other/unspecified	2,489	7%
Transport	1,176	3%
Other pedal cycle	1,037	3%
Cut/pierce	212	1%
Total	35,755	100%

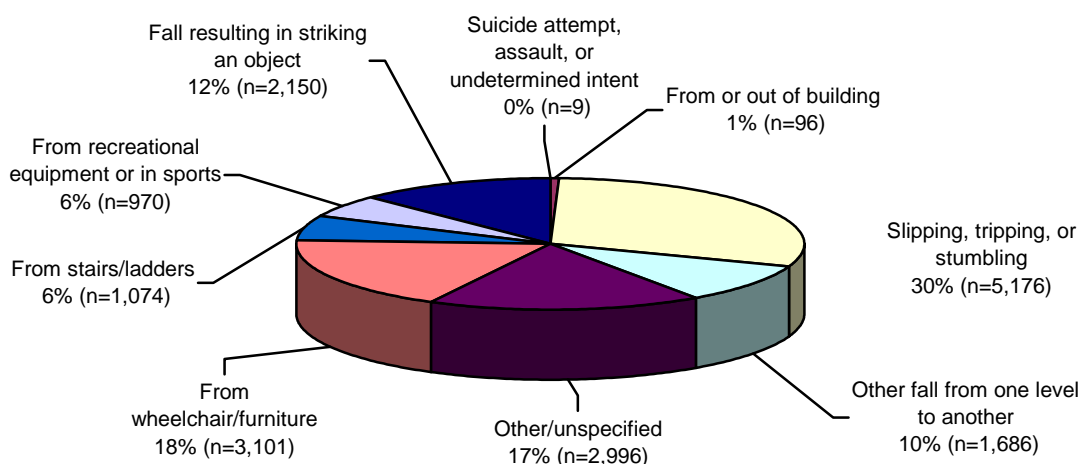
Non-Fatal Fall-Related Emergency Department Visits

There were 17,258 emergency department visits due to fall-related TBI. Forty-nine percent were among males (n=8,523,) and 51 percent were among females (n=8,735).

Nearly all of these falls were unintentional (n=17,249). Fifty percent of TBI emergency department visits due to falls were among individuals 19 years and younger (n=8,665).

Sixteen percent of the falls did not have contributing event information specified in the hospital discharge database (n=2,841). The most frequently specified contributing events to fall-related TBI were slipping, tripping, or stumbling (30 percent, n=5,176) and falls from furniture or wheelchairs (18 percent, n=3,101). Figure 18 shows TBI emergency department visits due to falls by contributing event.

Figure 18. TBI Emergency Department Visits due to Falls by Contributing Event (All Intents), Arizona 2008 (n=17,258)

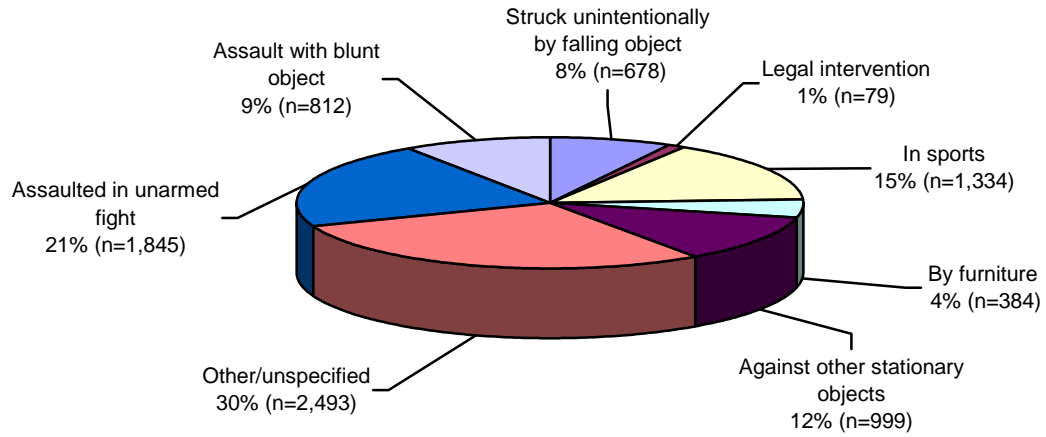


Non-Fatal Struck By/Against-Related TBI Emergency Department Visits

Struck by/against injuries include being struck by an object (such as falling furniture), striking against an object (such as the edge of a bathtub), or being struck by other people (such as when playing sports). Of the 8,624 TBI emergency department visits due to struck by/against injuries, 66 percent were among males (n=5,676) and 34 percent were among females (n=2,948). Sixty-eight percent of these injuries were unintentional (n=5,888), and 31 percent were assaults (n=2,657). Forty-nine percent of TBI emergency department visits from struck by/against injuries were among individuals 19 years and younger (n=4,264).

The emergency department discharge database did not include information regarding contributing event for 30 percent of the struck by/against injuries (n=2,471). The most frequently specified contributing events were assaults in unarmed fights (21 percent, n=1,845) and blows while playing sports (15 percent, n=1,334). Figure 19 shows TBI emergency department visits due to struck by/against injuries by contributing event.

Figure 19. TBI Emergency Department Visits due to Struck By/Against Injuries by Contributing Event (All Intent), Arizona 2008 (n=8,624)



Data Notes

All rates shown were calculated using the 2008 Arizona resident population estimates published by the Arizona Department of Health Services in *Arizona Health Status and Vital Statistics 2008*. Age-adjusted rates were standardized to the 2000 U.S. standard population using the direct standardization method. Age-adjusted rates have been presented when possible, as age-adjusting controls for the effects of age differences in populations (i.e., a large proportion of older adults or young children) and allows for more accurate rate comparisons.

Mortality data were tabulated from death certificates for Arizona residents who died in 2008. Inpatient hospitalization data were compiled from the 2008 Arizona Hospital Discharge Database. Emergency department visit data were compiled from the 2008 Arizona Emergency Department Discharge Database.

The discharge databases contain information from private, acute-care facilities in the state of Arizona, and do not include visits to federal facilities, such as Veterans' Affairs Hospitals or Indian Health Services facilities. The discharge databases do not contain data from urgent care facilities, private physician practices, or medical clinics. Additionally, discharge data include hospital transfers and readmissions, so a single injured individual may be counted more than once. These data should be interpreted as episodes of medical treatment, not individual injuries.

Codes from the International Classification of Diseases, Version 9, clinical modification (ICD-9-CM) were used for determining TBI cases among hospital and emergency department data. ICD-10 codes were used for mortality data. The specific codes used are described in *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations and Deaths*, published in 2006 by the U.S. Centers for Disease Control and Prevention (CDC). Traumatic brain injury-related inpatient hospitalizations and emergency department visits resulting from medical misadventures have been excluded from this report.

Appendix A. Definitions of Causes	
Cause	Definition
Fall	Includes falls from furniture, stairs, playground equipment, and those that occur while playing sports.
Firearm	Includes injuries from handguns, shotguns, BB guns, etc.
Unknown cause	Cause not listed.
Motor vehicle traffic	Includes collisions that occur on public highways and streets. These collisions may include pedestrians, pedal cyclists, motorcyclists, and occupants of motor vehicles.
Other land transport	Includes collisions involving railway transport or all-terrain vehicles operating off-road. This cause only applies to deaths and is not used in hospitalization or emergency department databases.
Other pedal cycle	Includes injured pedal cyclists struck by pedestrians, pedal cycles, or non-motorized vehicles.
Other/unspecified	Unspecified events or other rare events.
Struck by/against	Includes being struck by furniture, struck by other people while playing sports, or hit by objects while playing sports.
Transport	Other non-motorized, off-road vehicle, or rail transport. This cause only applies to hospitalization and emergency department databases and is not used on death certificates.