



Traumatic Brain Injury Data Report, 2004-2005

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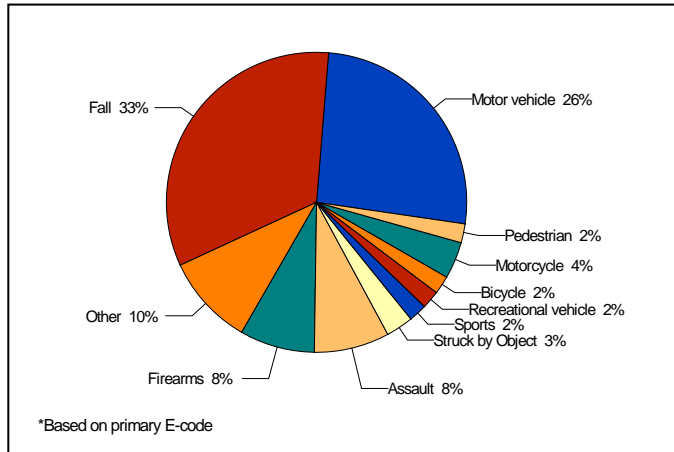
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Section 1: Traumatic Brain Injuries in Oklahoma, 2004-2005

Background

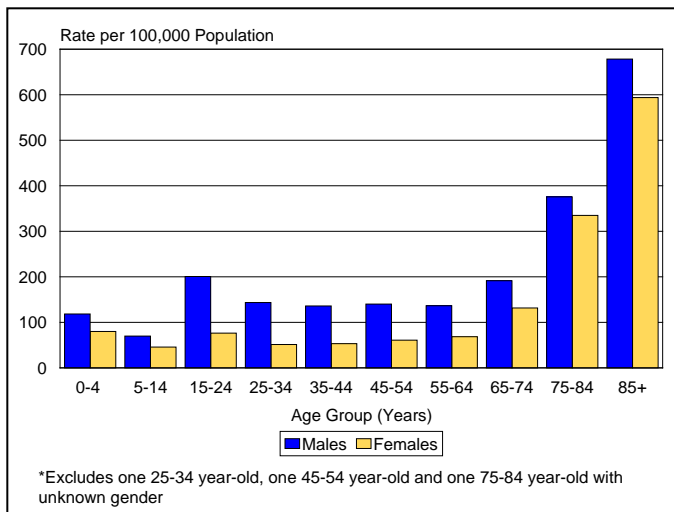
Statewide surveillance for hospitalized and fatal traumatic brain injuries (TBI) was conducted in Oklahoma using 2004 and 2005 hospital discharge data and Vital Statistics (death certificate) data. Persons discharged with the following *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes were included in surveillance: 800.0-801.9, 803.0-804.9, 850.0-854.1, 950.1-950.3, 959.01, and 995.55. Deaths were identified by death certificates coded with one of the following *International Classification of Diseases, Tenth Revision* (ICD-10) codes: S01.0-S01.9, S02.0, S02.1, S02.3, S02.7-S02.9, S04.0, S06.0-S06.9, S07.0, S07.1, S07.8, S07.9, S09.7-S09.9, T01.0, T02.0, T04.0, T06.0, T90.1, T90.2, T90.4, T90.5, T90.8, or T90.9. Only residents of Oklahoma were included. Oklahoma residents who died out of state were also included. Basic demographic data were collected for all cases. In addition, a stratified random sample of cases was selected for medical record review and detailed information on the injury was collected (see page 6, Section 2). Residents hospitalized out of state or at a federal facility, who survived, were not included in analyses. Therefore, the burden of TBI on Oklahoma's population may be greater than what is presented in this document. Rates were calculated using 2004 and 2005 bridged-race population estimates.

Figure 1. Traumatic Brain Injuries by Etiology*, Oklahoma, 2004-2005



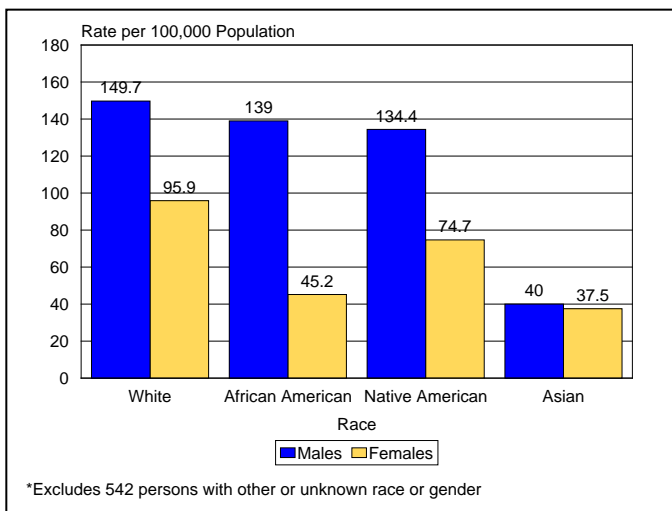
- A total of 8,781 Oklahoma residents suffered a TBI in 2004-2005 (4,386 in 2004 and 4,395 in 2005).
- Falls and motor vehicle crashes were the leading causes of all TBI.
- Gunshot wounds and motor vehicle crashes were the leading causes of TBI preadmission deaths.

Figure 2. Traumatic Brain Injury Rates by Age Group* and Gender, Oklahoma, 2004-2005



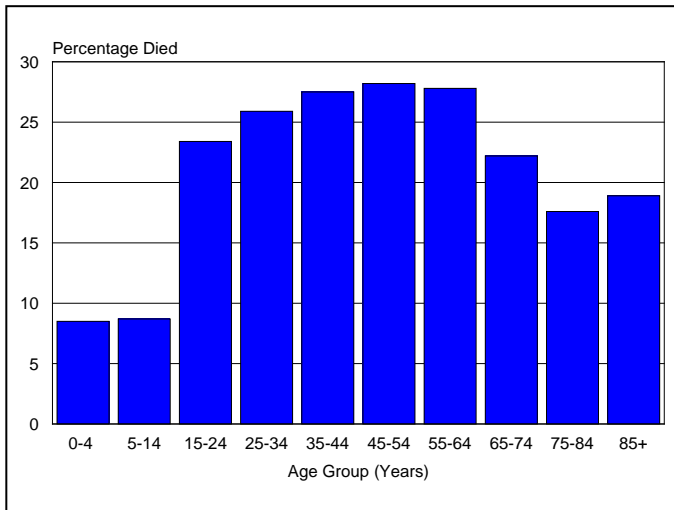
- The age range of persons who suffered a TBI was less than 1 year to 105 years, with an average age of 47 years.
- The injury rate was highest for persons 85 years and older, followed by persons 75-84 years, for both males and females.
- Males 15-24 years had the third highest rate among males, while the third highest rate for females was in the 65-74 year age group.
- Males were over 1.5 times more likely to be injured than females (155.5 and 93.8 injuries per 100,000 population, respectively).

Figure 3. Traumatic Brain Injury Rates by Gender and Race*, Oklahoma, 2004-2005



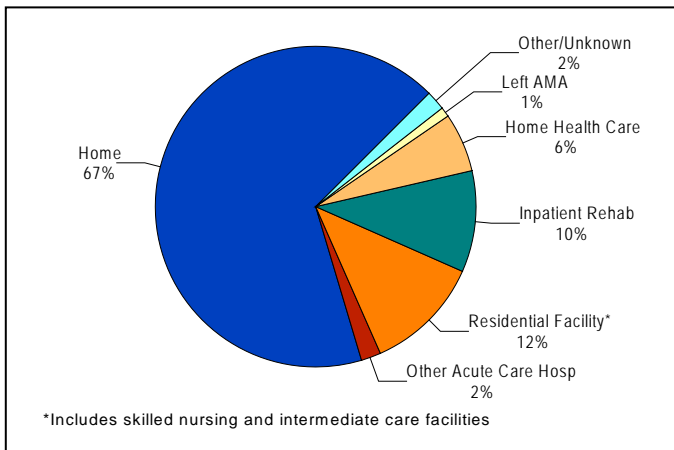
- Whites had the highest rate of TBI (122.4 injuries per 100,000 population), followed by Native Americans (103.9), African Americans (91.5), and Asians (38.7).
- TBI rates were highest among white males, followed closely by African American and Native American males.
- Rates were 3 times higher for African American males than for African American females.
- Rates were lowest for Asian females; all females had lower rates than their male counterparts.
- In terms of ethnicity, Hispanic males had an injury rate nearly 3 times higher than Hispanic females (data not shown; 111.5 and 39.6 injuries per 100,000 population, respectively).

Figure 4. Traumatic Brain Injury Case-Fatality Rates by Age Group, Oklahoma, 2004-2005



- There was a total of 1,927 deaths (22%) from a TBI in 2004-2005.
- Persons 45-54 years had the highest fatality rate (28%), while children under 15 years had the lowest (9%).
- Males had a higher case-fatality rate than females (25% compared to 17%).

Figure 5. Traumatic Brain Injury Survivors by Hospital Discharge Status, Oklahoma, 2004-2005



- Of the 8,781 persons who suffered a TBI in 2004-2005, 78% survived.
- The majority of TBI survivors (67%) were discharged home after their hospital stay.
- Ten percent of survivors went to an inpatient rehabilitation facility upon discharge.
- Twelve percent of survivors were discharged to a skilled nursing facility or nursing home.

Table 1. Traumatic Brain Injury Rates by County of Residence*, Oklahoma, 2004-2005

County	2004-2005 Population	Number of Cases	Annual Rate
Harmon	6,044	24	397.1
Major	14,685	47	320.1
Dewey	9,167	24	261.8
Beckham	37,161	91	244.9
Pushmataha	23,403	56	239.3
Adair	43,684	94	215.2
Greer	11,753	25	212.7
Washita	22,881	48	209.8
Harper	6,731	14	208.0
Roger Mills	6,561	13	198.1
Craig	29,928	59	197.1
Hughes	27,824	50	179.7
Choctaw	30,692	55	179.2
McClain	59,060	105	177.8
Pawnee	33,561	59	175.8
Haskell	24,165	41	169.7
Noble	22,436	38	169.4
Cotton	13,040	22	168.7
Jackson	53,406	89	166.6
Latimer	21,218	35	165.0
Atoka	28,632	47	164.2
Ellis	7,926	13	164.0
Blaine	25,726	41	159.4
McIntosh	39,680	63	158.8
Jefferson	12,929	20	154.7
Kiowa	19,714	30	152.2
Garvin	54,264	82	151.1
Ottawa	65,581	99	151.0
McCurtain	67,707	102	150.6
Johnston	20,677	31	149.9
Alfalfa	11,547	17	147.2
Bryan	75,259	110	146.2
Muskogee	141,057	201	142.5
Lincoln	64,621	92	142.4
Pontotoc	70,194	99	141.0
Kingfisher	28,321	39	137.7
Coal	11,637	16	137.5
Cherokee	88,557	121	136.6
Seminole	49,301	67	135.9

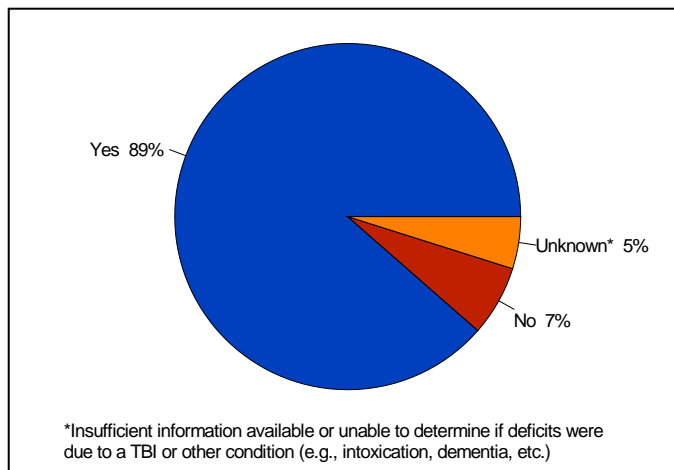
County	2004-2005 Population	Number of Cases	Annual Rate
Grant	9,580	13	135.7
Tulsa	1,138,703	1,532	134.5
Mayes	78,570	105	133.6
Creek	137,253	177	129.0
Pittsburg	88,727	114	128.5
Osage	90,340	115	127.3
Murray	25,504	32	125.5
State of Oklahoma	7,066,269	8,781	124.3
Garfield	114,123	141	123.6
Caddo	60,243	74	122.8
Logan	72,504	89	122.8
Marshall	28,295	33	116.6
Okmulgee	79,379	91	114.6
Stephens	85,663	98	114.4
Washington	98,032	112	114.2
Oklahoma	1,362,842	1,548	113.6
Payne	146,487	166	113.3
Okfuskee	22,996	26	113.1
Woods	16,992	19	111.8
Canadian	193,916	216	111.4
Pottawatomie	135,745	148	109.0
Rogers	159,459	171	107.2
Custer	50,383	54	107.2
Carter	93,873	100	106.5
Cimarron	5,708	6	105.1
Woodward	37,916	39	102.9
Nowata	21,501	22	102.3
Wagoner	126,903	126	99.3
Kay	92,907	92	99.0
Tillman	17,244	17	98.6
Comanche	223,398	218	97.6
Grady	97,602	92	94.3
Cleveland	445,238	399	89.6
LeFlore	98,517	82	83.2
Beaver	10,861	9	82.9
Sequoyah	81,279	63	77.5
Love	18,220	14	76.8
Delaware	78,231	60	76.7
Texas	40,405	23	56.9

*County of residence was unknown for 66 persons.

Section 2: Sampled Hospitalized Traumatic Brain Injuries in Oklahoma, 2004-2005

In order to obtain detailed information on the circumstances and outcomes of traumatic brain injuries (TBI) in Oklahoma, a random sample of cases was selected based on hospital size. The medical records of sampled cases were reviewed by trained abstractors and detailed data were recorded and analyzed. Preadmission deaths and hospitalizations occurring at facilities outside of Oklahoma were not eligible to be selected in the sample. In 2004, a random sample of 1,200 records was drawn, which resulted in 1,191 successfully abstracted cases. In 2005, the random sample consisted of 1,051 records, producing 1,029 successful reviews. The most common reasons that a record could not be reviewed or did not qualify as a successful abstraction included the medical record was not located by hospital staff, the patient was determined not to be an Oklahoma resident, or the record was found to be an old injury or a subsequent visit for a previously abstracted injury (e.g., a prevalent case). Since these records were selected randomly stratified by hospital size, the samples are representative of all hospitalized TBI cases in Oklahoma.

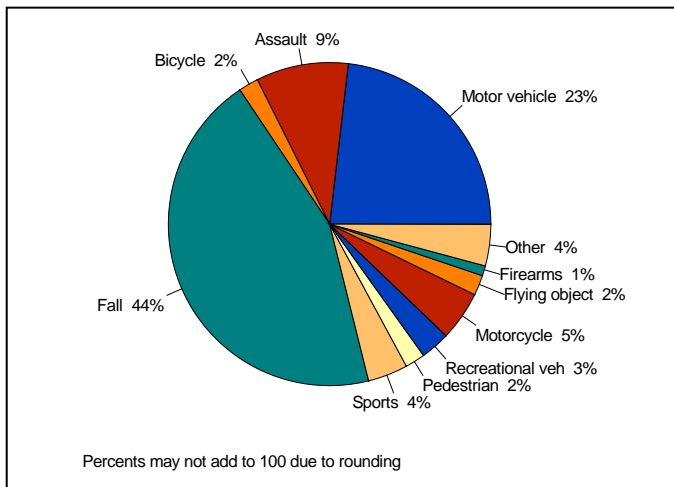
Figure 7. Sampled Hospitalized Traumatic Brain Injuries Meeting the Clinical Case Definition, Oklahoma, 2004-2005



- All sampled injuries met the case inclusion criteria, which are the code-based definitions provided in the Section One background.
- The Centers for Disease Control and Prevention has also published a clinical case definition for traumatic brain injuries.
- To meet the clinical case definition, one or more of the following conditions must be documented in the medical record and attributed to the head injury:
 - Decreased level of consciousness

- Amnesia
- Skull fracture
- Intracranial lesion
- Neurological or neuropsychological abnormality
- The majority of sampled records (89%) met the clinical case definition.
- Subsequent analyses, however, include all cases meeting the code-based inclusion criteria (n = 2220).

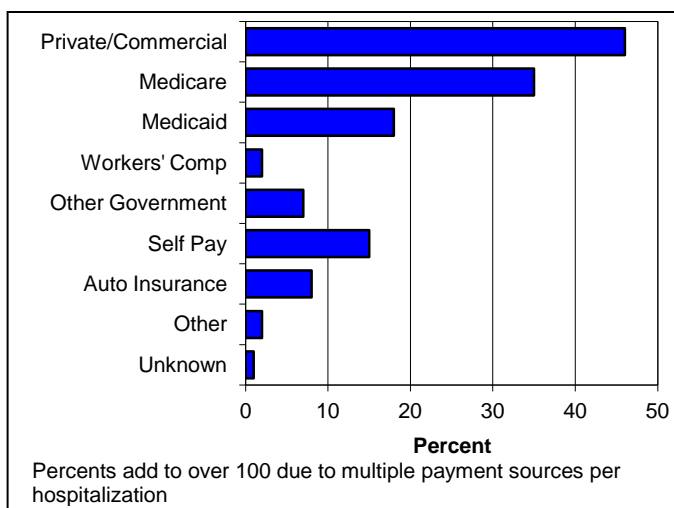
Figure 8. Sampled Hospitalized Traumatic Brain Injuries by Etiology, Oklahoma, 2004-2005



- Falls and motor vehicle crashes were the primary mechanisms of TBI.
- Of the motor vehicle crash-related injuries, 64% were drivers, 31% were passengers, and the remaining 5% had an unknown seating position. Forty-three percent of injured patients were reported to be using a safety belt or child safety seat.
- The majority of falls (60%) occurred in a home or yard, followed by 17% in a residential institution, such as a nursing home or hospital.

- Of the motorcycle injuries, 19% of patients were reported to be wearing a helmet. Twelve percent of patients injured in bicycle-related incidents were reported to be wearing a helmet.
- Over one-half of the sports-related injuries resulted from horseback riding.
- Of the assaults, 7% were the result of intimate partner violence and 6% were shaken babies. Overall, the most common methods of assault were blunt instruments (36%) and fists/kicks (27%).
- The majority of hospitalized TBIs (88%) occurred unintentionally; 9% were caused intentionally by another person; 1% were self-inflicted injuries; and 2% had an unknown intentionality.
- The total number of days in the hospital ranged from 1 to 148; the average stay was 7 days.

Figure 9. Sampled Hospitalized Traumatic Brain Injuries by Payment Source, Oklahoma, 2004-2005



- Nearly one-half of all hospitalizations were paid at least in part by private or commercial insurance.
- Medicare, Medicaid, or other government programs paid at least a part of 59% of the hospitalizations.
- Fifteen percent of the hospitalizations were self pay.

Table 2. Sampled Hospitalized Nonfatal Traumatic Brain Injuries by Etiology and Severity, Oklahoma, 2004-2005

Abbreviated Injury Scale (AIS)					
Etiology	2 Moderate	3 Serious	4 Severe	5 Critical	Unknown
Fall	55%	8%	21%	15%	1%
Motor Vehicle	60%	15%	16%	9%	<1%
Assault	48%	13%	30%	10%	0%
Motorcycle	49%	10%	30%	12%	0%
Sports	60%	13%	21%	6%	0%
Recreational Vehicle	50%	16%	28%	7%	0%
Bicycle	41%	22%	27%	10%	0%
Flying Object	50%	17%	29%	4%	0%
Pedestrian	40%	23%	28%	7%	2%
Firearms	14%	21%	43%	21%	0%
Other	51%	11%	24%	12%	3%
TOTAL	54%	12%	22%	12%	<1%

Percents may not add to 100 due to rounding.

- Higher Abbreviated Injury Scale (AIS) scores indicate more severe brain injury. An AIS score of 4 indicates a severe, life-threatening injury where survival is probable. An AIS score of 5 is given for critical injuries with uncertain survivability.
- Among survivors, the most severe TBIs resulted from firearms, falls, and motorcycle injuries.
- More than half of the TBIs were of moderate severity (AIS score 2); 12% were critical injuries.
- Sports- and motor vehicle-related injuries had the highest proportion of moderate severity TBIs, while firearms had the lowest (14%).

Table 3. Imaging Characteristics of Sampled Hospitalized Traumatic Brain Injuries, Oklahoma, 2004-2005

Variable	Level	Percentage
CT*/MRI** of head performed	Yes	95%
	No	5%
CT*/MRI** results	Abnormal (likely due to TBI)	52%
	Normal	45%
	Unknown	2%
Skull fracture	Diagnosed, with imaging/surgery	17%
	Diagnosed, not confirmed by imaging	1%
	No/Unknown	81%
Intracranial lesion	Lesion documented by imaging/surgery	43%
	No lesion found on imaging	50%
	No imaging/Unknown	7%

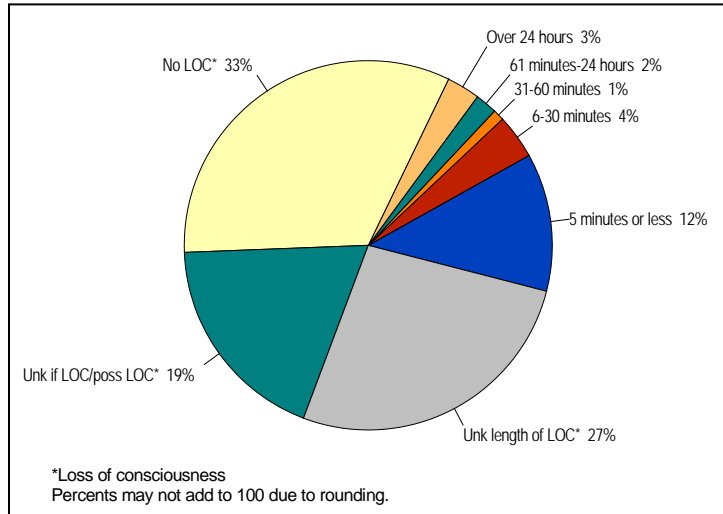
*Computed tomography scan

**Magnetic resonance imaging

Percents may not add to 100 due to rounding.

- Nearly all of the sampled TBI cases had a CT scan or MRI of the head performed; over 50% had documented abnormalities likely due to the TBI.
- Nearly one-fifth of the sample suffered a skull fracture and over 40% had an intracranial lesion.

Figure 10. Sampled Hospitalized Traumatic Brain Injuries by Length of Time of Unconsciousness, Oklahoma, 2004-2005



- Nearly one-half of the patients were documented to have lost consciousness for some length of time as a result of their injury, and another one-fifth had possible, questionable, or unknown unconsciousness.
- One-third had no reported loss of consciousness.
- Approximately one-fourth of persons with a TBI experienced some form of amnesia and did not remember events preceding, during and/or after their injury.

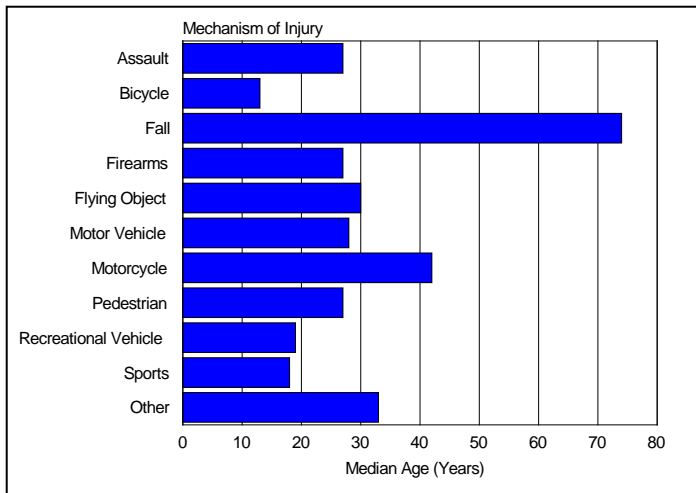
Table 4. Sampled Hospitalized Traumatic Brain Injuries by Etiology and Glasgow Coma Scale Score, Oklahoma, 2004-2005

Etiology	Glasgow Coma Scale (GCS)				
	≤8 Coma	9-12 Moderate Impairment	13-14 Minimal Impairment	15 No Impairment	Invalid or Unknown
Fall	6%	6%	17%	34%	37%
Motor Vehicle	16%	12%	24%	35%	14%
Assault	8%	8%	16%	29%	39%
Motorcycle	22%	10%	30%	26%	13%
Sports	4%	9%	18%	39%	30%
Recreational Vehicle	11%	8%	23%	34%	23%
Bicycle	5%	14%	10%	53%	24%
Flying Object	6%	2%	17%	37%	23%
Pedestrian	17%	9%	26%	24%	11%
Firearms	55%	0%	3%	0%	17%
Other	18%	7%	10%	26%	39%
TOTAL	10%	8%	19%	34%	29%

Percents may not add to 100 due to rounding.

- Lower Glasgow Coma Scale (GCS) scores indicate a lower level of consciousness. Scores are based on three elements: best eye response, best verbal response, and best motor response. Scores are invalid or not applicable in situations where each component cannot be accurately assessed (e.g., the patient is intubated, sedated, intoxicated, not fully resuscitated, mentally impaired, etc.).
- The lowest valid score assigned prior to or immediately upon hospital admission was abstracted and included in this analysis.
- Motorcycle, motor vehicle, pedestrian, and firearm injuries had the lowest proportions of invalid or unknown scores and also had the largest proportions of coma or severely impaired levels of consciousness.

Figure 11. Sampled Hospitalized Traumatic Brain Injuries by Etiology and Median Age, Oklahoma, 2004-2005



- Bicycle and sports-related injuries occurred more often in younger ages (median ages 13 and 18 years, respectively).
- Falls were more likely to occur in the older population (median age 74 years).

Table 5. Sampled Hospitalized Traumatic Brain Injuries by Etiology and Drug and Alcohol Use, Oklahoma, 2004-2005

Etiology	Definite/Likely Alcohol Use Prior to Injury	Definite/Likely Drug Use Prior to Injury
Fall	7%	5%
Motor Vehicle	20%	19%
Assault	43%	23%
Motorcycle	28%	16%
Sports	4%	3%
Recreational Vehicle	11%	8%
Bicycle	7%	7%
Flying Object	2%	8%
Pedestrian	20%	9%
Firearms	34%	21%
Other	17%	23%
TOTAL	15%	11%

- There was a higher proportion of alcohol use among those injured in assaults or by firearms, while alcohol use was less prevalent in bicycle, sports, and fall-related injuries.
- Of those with a positive blood alcohol concentration, 85% tested above 0.08 g/dL; results ranged from 0.01 to 0.51 g/dL.
- Over one-fifth of all motor vehicle crashes, assaults, and firearm injuries involved definite or likely drug use prior to the injury.

Table 6. Sampled Hospitalized Traumatic Brain Injuries by Etiology and Glasgow Outcome Scale Score, Oklahoma, 2004-2005

Etiology	Glasgow Outcome Scale (GOS)					
	1 Death	2 Persistent Vegetative State	3 Severe Disability	4 Moderate Disability	5 Good Recovery or Minor Deficits	Unknown
Fall	8%	1%	4%	17%	67%	2%
Motor Vehicle	7%	< 1%	4%	12%	76%	1%
Assault	4%	< 1%	2%	9%	81%	3%
Motorcycle	9%	0%	5%	17%	70%	0%
Sports	1%	0%	0%	4%	95%	0%
Recreational Vehicle	5%	2%	2%	7%	85%	0%
Bicycle	2%	0%	0%	2%	95%	0%
Flying Object	2%	0%	2%	11%	85%	0%
Pedestrian	7%	0%	7%	13%	72%	2%
Firearms	52%	0%	14%	3%	31%	0%
Other	11%	0%	1%	10%	76%	2%
TOTAL	8%	< 1%	4%	13%	73%	2%

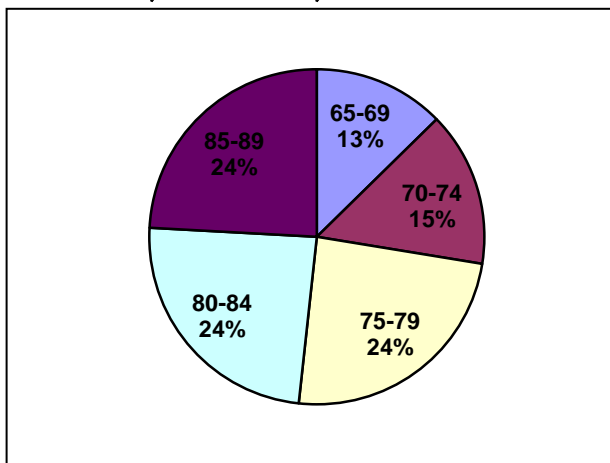
Percents may not add to 100 due to rounding.

- Nearly three-quarters of patients had a GOS score of 5, which indicates a good recovery; the person is independent and may resume a “normal” life , but may have minor deficits.
- Persons injured from a firearm, fall, or motorcycle were less likely to have a good recovery and more likely to die.
- Sports- and bicycle-related TBIs were more likely than other etiologies to result in a good recovery. Firearm injuries had the poorest outcomes.

Section 3: Profile of Sampled Hospitalized Traumatic Brain Injuries Resulting from Falls among Persons 65 Years of Age and Older in Oklahoma, 2005

Falls among the older population, both nationally and in Oklahoma, are a growing public health problem. As the country's population ages, the problem will likely continue to worsen. Of the 4,395 TBIs in Oklahoma in 2005, 1,370 occurred in persons 65 years of age or older. Sixty-nine percent of these injuries were falls. In order to obtain more detailed information surrounding these incidents, supplemental data were abstracted from all 2005 sampled records that involved a patient 65 years of age or older who was injured in a fall. Of the 1,029 successfully abstracted records in 2005, 290 (28%) met this fall criteria.

Figure 12. Sampled Hospitalized Fall-Related Traumatic Brain Injuries by Age Group, 65 Years and Older, Oklahoma, 2005



- The majority of fall-related injuries occurred among persons between the ages of 75 and 89 years.
- Fifty-eight percent of patients were female.
- The median age of males was 79 years and the median for females was 82 years.
- Eighty-six percent of patients had one or more of the following conditions documented in the record: skull fracture, intracranial lesion, amnesia, decreased level of consciousness, or neurological/neuropsychological abnormalities.
- Fifty-three percent of patients had abnormal

imaging results that were likely due to the TBI; 5% were diagnosed with a skull fracture, while nearly 50% had an intracranial lesion.

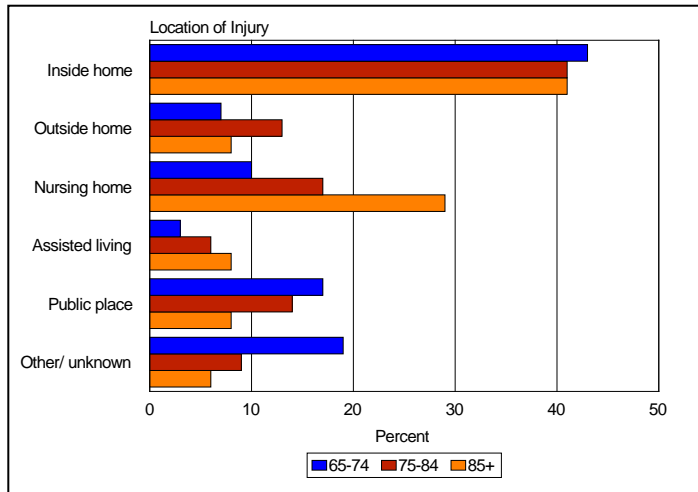
Table 7. Sampled Hospitalized Fall-Related Traumatic Brain Injuries by Health History, 65 Years and Older, Oklahoma, 2005

Health Condition	Percent of Patients with a Documented History of the Condition		
	Male	Female	Total
Alzheimer's disease/dementia	20%	35%	29%
Arthritis	26%	40%	34%
Atrial fibrillation/pacemaker	33%	23%	27%
Cerebrovascular accident/stroke	32%	31%	31%
Depression/bipolar disorder	15%	29%	23%
Diabetes	30%	25%	27%
Hypertension	62%	77%	70%
Incontinence	7%	15%	12%
Multiple Sclerosis	0%	0%	0%
Osteoporosis	1%	19%	11%
Parkinson's disease	6%	7%	6%
Peripheral neuropathy	3%	4%	3%
Recent acute illness	15%	20%	18%
Seizures/epilepsy	7%	10%	9%
Syncope*	8%	6%	7%
Vision problems	26%	29%	28%

*Does not include syncope related to the most recent fall

- Three percent of the sampled records had no documentation of any of the listed health conditions; 97% had a history of one or more.
- Taking multiple medications has been shown to increase one's risk of falling. Seventy-nine percent of patients were on four or more prescription medications at the time of the fall.
- The use of anticoagulant and antiplatelet medications may put TBI patients at increased risk of hemorrhagic complications. Over one-half of the sampled patients were on anticoagulant therapy at the time of the fall. Twenty-five percent were on aspirin only; 20% were on a prescription medication; and 12% were on both aspirin and a prescription medication.
- Forty-one percent of males and 39% of females had a documented history of previous falls, which may or may not have required medical treatment.
- Only 2% of patients also suffered a hip fracture as a result of the most recent fall, and only 1% sustained a wrist fracture.

Figure 13. Sampled Hospitalized Fall-Related Traumatic Brain Injuries by Location of Injury and Age Group, 65 Years and Older, Oklahoma, 2005



- Most patients (72%) resided in a private home prior to hospital admission; 20% lived in a nursing home and 8% at an assisted living facility.
- More injuries occurred at home than any other location. The most common areas where injuries occurred inside the home were the bedroom and bathroom.
- Males were more likely to be injured outside their home than females, while females were more likely to be injured in a nursing home than males.
- The most common public areas where injuries occurred were hospitals (30%), parking lots (14%), and retail stores (14%).
- Of those injuries with a known time of occurrence, approximately two-thirds occurred during the morning and afternoon hours; falls were least likely during the overnight hours (midnight-5:59 a.m.).

Table 8. Sampled Hospitalized Fall-Related Traumatic Brain Injuries by Body Position at the Time of the Fall and Glasgow Outcome Scale Score, 65 Years and Older, Oklahoma, 2005

Body Position/ Mechanics	Glasgow Outcome Scale (GOS)						Total
	1 Death	2 Persistent Vegetative State	3 Severe Disability	4 Moderate Disability	5 Good Recovery or Minor Deficits	Unknown	
Lying down	13%	0%	19%	19%	50%	0%	6%
Sitting	6%	0%	1%	28%	56%	0%	6%
Standing	3%	0%	8%	28%	60%	3%	14%
Walking	7%	0%	4%	28%	59%	1%	26%
Climbing	0%	0%	0%	50%	50%	0%	1%
Transitioning from lying down/sitting to standing	20%	0%	0%	7%	73%	0%	5%
Transitioning from standing to lying down/sitting	0%	0%	0%	50%	50%	0%	1%
Unknown	11%	2%	8%	23%	53%	2%	42%
Total	9%	1%	7%	24%	57%	2%	

Percents may not add to 100 due to rounding.

- Forty percent of falls occurred while the patient was standing or walking. Slipping, tripping, and experiencing a syncopal episode were the factors most commonly associated with all falls.
- Of the nonfatal falls, 41% were severe or critical head injuries as evidenced by Abbreviated Injury Scale scores of 4 or 5.
- One-fourth of patients suffered moderate disabilities as a result of their fall, meaning that they are disabled, but can participate in activities of daily living and be self-sufficient. While the majority of patients had a good recovery, 9% died.
- Twenty-eight percent of falls were known to involve a loss of consciousness; of these cases, 18% had a time of unconsciousness over one hour.
- Half of all falls were known to involve some type of object and 7% involved more than one object. The most common objects included beds, chairs, sidewalks, and curbs.

Table 9. Characteristics of Sampled Hospitalized Fall-Related Traumatic Brain Injuries by History of Previous Falls, 65 Years and Older, Oklahoma, 2005

	History of Previous Falls	No or Unknown History of Previous Falls
Median age	82 years	80 years
Assisted living/nursing home residence prior to admission	34%	24%
GCS* ≤8	9%	3%
AIS** 4-5	50%	39%
Acute intracranial lesion diagnosed***	59%	45%
Skull fracture diagnosed	3%	6%
Documented loss of consciousness	22%	32%
Discharged home	18%	38%
Severe disability or death	22%	14%
*Initial lowest Glasgow Coma Scale score (≤8 indicates coma)		
**Abbreviated Injury Scale Score (4-5 indicates severe or critical injuries)		
***Of those with a CT scan or MRI of the head (95%)		

- Persons with a history of previous falls (with or without medical treatment) were slightly older and more likely to have resided in an assisted living facility or a nursing home than those with no fall history.
- In general, those with a history of falls had more severe and debilitating injuries and were less likely to be discharged home than those without such a history.