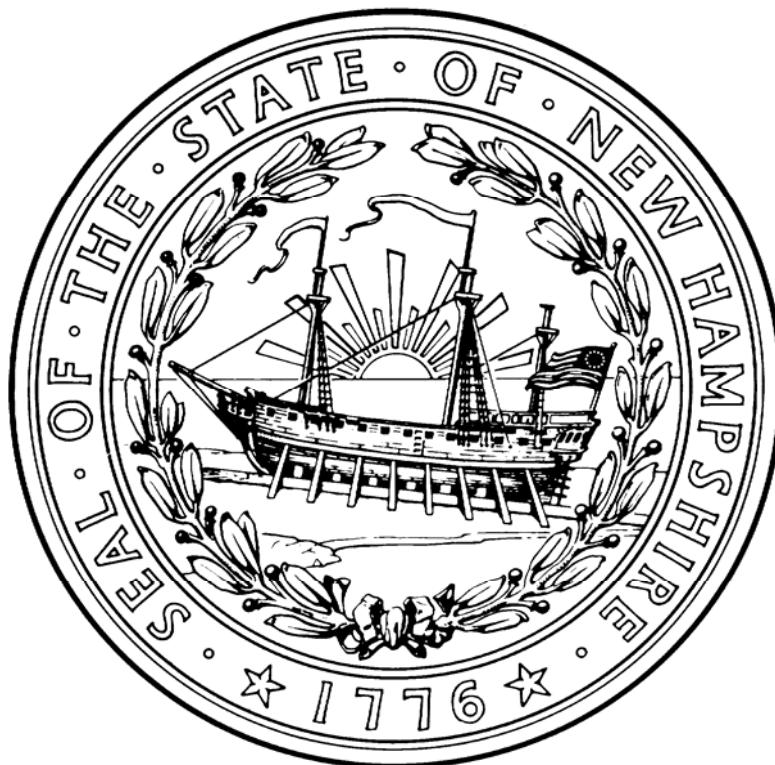


TRAUMATIC BRAIN INJURY

Occurrence and Mortality in New Hampshire

2009 REPORT

Based on 2000-2005 surveillance data



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Occurrence and Mortality in
New Hampshire
Report issued 2009
Based on 2000-2005 surveillance data**

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Introduction

Traumatic Brain Injuries Are A Public Health Issue In New Hampshire.

Traumatic brain injury (TBI), often referred to as the “Silent Epidemic”, presents as an often unseen and underreported public health issue. According to the CDC (1), at minimum 5.3 million Americans live with the long-term consequences of a TBI. Each year an estimated 1.4 million TBI-related deaths, hospitalizations, and ED visits occur in the United States (1). This report is a comprehensive effort to describe the frequency, causes, and demographic characteristics of new cases (2000-2005) of traumatic brain injuries (TBI) among residents of New Hampshire.

What is a traumatic brain injury and why should we be concerned? A traumatic brain injury is caused by a blow or jolt to the head, or a penetrating head injury that disrupts the normal function of the brain. Such a blow can launch the brain on a collision course with the inside of the skull. The skull itself can often withstand a forceful external impact without fracturing. The result, an injured brain inside an intact skull, is known as a closed-head injury. A traumatic brain injury may also occur when a projectile, such as a bullet, rock or fragment of a fractured skull, actually penetrates the brain. This type is much less common and is known as an open-head injury. In both instances, these injuries can lead to primary injuries, occurring immediately as a direct result of the force applied to the brain such as contusions, lacerations, hemorrhages and diffuse axonal injury. They can also cause secondary injuries, which evolve over time causing conditions such as cerebral edema, cerebral infarction, cerebral anoxia or hypoxia, cerebral infection, seizures and changes in brain chemistry and neurotransmitter functioning. Not all blows or jolts to the head result in a TBI. The severity of a TBI may range from “mild”, or a brief change in mental status or consciousness, to “severe”, or an extended period of unconsciousness or amnesia after the injury.

Why are traumatic brain injuries a public health issue? Traumatic brain injuries can cause many different types of changes to the way a person thinks and understands the world around him. They can affect senses such as touch, taste, and smell. A traumatic brain injury may interfere with communication and the expression of one’s thoughts. It may also facilitate social inappropriateness, depression, anxiety, personality changes, aggression and acting out (1). Additionally, changes in attention and concentration, memory and executive functioning are all hallmarks of traumatic brain injury.

Traumatic brain injuries may also increase a person’s risk for developing Alzheimer’s disease, Parkinson’s disease, and other brain disorders that become more prevalent as one ages (1). Sustaining a traumatic brain injury can also lead to epilepsy.

Repeated mild traumatic brain injuries that occur over months and even years can result in additive neurological and cognitive deficits. Repeated mild traumatic brain injuries over hours, days, or weeks, under certain circumstances can be fatal (5).

Brain injuries do not heal like other injuries. Recovery is a functional recovery, based on mechanisms that remain uncertain. No brain injuries are alike and the consequence of

two similar injuries may be very different. Symptoms may appear right away or may not be present for days or weeks after the injury.

In the past, most people who sustained a serious brain injury died. Today, with advances in medicine and technology, most survive, often living with permanent disabilities. The implication for New Hampshire of improved acute medical treatment at the critical “life saving” stage of injury is that the number of people needing extended medical treatment, rehabilitation, and lifelong supports for complex and chronic conditions are increasing. Thus, traumatic brain injuries can be a very serious injury that requires ongoing and often lifelong supports, with significant impact on the people and families it affects.

How many?

- In 2005 in New Hampshire, there were 204 deaths, 831 people hospitalized, and 8,291 people treated in an emergency room.
- In New Hampshire during the years 2001-2005, for every death due to a traumatic brain injury, there were approximately four people who were hospitalized and 37 people who were treated and released from an emergency department due to a traumatic brain injury.
- Recent data shows that on average in the United States, 50,000 people die, 235,000 are hospitalized, and 1.1 million are treated and released from an emergency department annually (3).
- New Hampshire’s emergency department utilization compared to deaths is higher (1 to 37) than it is nationally (1 to 22).

Table 1: Total number of hospital discharges, emergency department discharges and deaths of New Hampshire (NH) residents from Traumatic Brain Injury (TBI), between the years 2001 and 2005

Year	TBI Inpatient Discharges	TBI Emergency Department Discharges	TBI Deaths
2001	695	6,229	186
2002	741	6,236	171
2003	757	6,750	188
2004	831	7,225	188
2005	831	8,201	204

The number of deaths, inpatient visits, and emergency department discharges from Traumatic Brain Injury (TBI) has increased from 2001 to 2005. The only significant change when you look at rates is in emergency department visits (which will be discussed later in the report on page 15.)

It is important to note that the number of people with traumatic brain injury who are not seen in an emergency department or who do not seek medical care is unknown.

Who is sustaining traumatic brain injuries?

- In New Hampshire, as it is nationally, adults age 75 years and older have the highest rates of TBI-related mortality or deaths. Infants and children have the lowest mortality rate due to TBI.
- Males in New Hampshire are more likely to die, become hospitalized, and visit an emergency department from traumatic brain injuries than are their female counterparts.
- This difference between males and females increases significantly between 2004 and 2005 with respect to emergency department visits.
- Nationally, the two age groups at highest risk for a traumatic brain injury in general are 0 to 4 year olds and 15 to 19 year olds (1).
- Coos county residents had a higher rate of hospitalizations for TBI than did any other county. Rates of hospitalization are significantly higher than all other counties other than Carroll and Sullivan.
- Coos county residents had a significantly higher rate for emergency department visits due to a TBI than every county except Carroll.

What are the leading causes of traumatic brain injuries in New Hampshire and nationally?

- For deaths due to a traumatic brain injury, the leading mechanisms were firearms (suicides primarily), motor vehicles, and falls. Adolescents were hospitalized for TBI mostly due to motor vehicle crashes as opposed to the elderly who were hospitalized for TBI mostly due to falls.
- Falls are the highest age-adjusted cause of hospitalizations due to TBI in New Hampshire, followed by motor vehicle crashes.
- For emergency room visits, falls were the number one cause of traumatic brain injuries for all age groups, followed by struck by or against and then motor vehicle crashes. Struck by or against is defined as colliding with a stationary or moving object.
- Adults aged 75 and older and children 0 to 4 had the highest rates of TBI due to falls in the emergency room.
- Adolescents between the ages of 15 to 24 had the highest rate of TBI in the emergency room due to motor vehicle crashes.
- Nationally, falls are the leading cause of traumatic brain injuries overall (1). However, firearm use is the leading cause of death related to TBI (5).
- Approximately 1.6 – 3.8 million sports- and recreation-related TBIs occur in the United States each year (3). Most of these are mild TBIs that are not treated in a hospital or emergency department.

Are TBIs costly? Traumatic brain injuries are very costly. Direct medical costs and indirect costs such as lost productivity of TBI totaled an estimated \$60 billion in the United States in 2000 (4). In New Hampshire, the cost of fatalities on average in years 2000-2004, due to traumatic brain injuries was estimated at an aggregate cost of

\$568,031,000. Each fatality due to TBI during those years cost an estimated \$3,242,186. This takes into account the medical costs, lost productivity and quality of life costs (6). In New Hampshire, for hospitalizations due to TBI in 2003, the total aggregate cost was \$368,803,522 (in 2006 dollars). Each hospitalization in 2003 due to TBI cost an estimated, \$701, 278. Again this takes in medical costs, lost productivity, and quality of life (6).

Are traumatic brain injuries preventable? Many of the causes of traumatic brain injuries are predictable and preventable. Prevention includes, but is not limited to:

- Wearing a seat belt every time you drive or ride in a motor vehicle.
- Buckling your child in the car using a child safety seat, booster seat, or seat belt (according to the child's height, weight, and age).
- Never driving while under the influence of alcohol or drugs.
- Storing firearms, unloaded, in a locked cabinet or safe. Store bullets in a separate location.
- Wearing a helmet while riding a bicycle, skateboard, motorcycle, snowmobile or all-terrain vehicle. Also wear head protection when you bat or run bases, ski, skate, ride a horse, or play a contact sport.
- Installing safety features in your home, such as handrails on stairways, nonslip mats in the bathtub, grab bars in the bathroom, window guards, and safety gates on the top and bottom of stairs (especially when young children are around) to limit falls. An exercise program can improve strength, balance and coordination. Regular vision tests also can help lower the risk of falling.
- Making sure the surface on your child's playground is made of shock-absorbing material.

Methodology

I. Data Analysis

The data sources selected to analyze were TBI hospital discharge data from both inpatient and emergency department visits, and vital record death certificate data. Staff of the New Hampshire Department of Public Health, Health Statistics and Data Management Section performed the analysis.

A. Death Data Source: Bureau of Data and Systems Management (BDSM), Office of Medicaid Business and Policy (OMBP), New Hampshire Department of Health and Human Services (NH DHHS), and the New Hampshire Department of State, Division of Vital Records Administration, [2001-2005]. Underlying cause of death is classified in accordance with the International Classification of Disease. Deaths for 1999 and beyond are classified using the Tenth Revision (ICD-10).

B. Hospital Discharge Data Source: Bureau of Data and Systems Management (BDSM), Office of Medicaid Business and Policy (OMBP), New Hampshire Department of Health and Human Services (NH DHHS), with assistance from a DHHS contractor, [2000-2005].

II. Case Inclusion Criteria

The above datasets were filtered to include only residents of New Hampshire with the presence of codes indicating TBI. In the hospital data, TBI codes were searched in the principle diagnosis field and the nine secondary diagnosis fields. The death data was searched in the certified underlying cause of death field and the fifteen “Rec_Axis” code fields. The following is a list of the ICD-9 and ICD-10 codes included in this study:

A. ICD-9, Hospital Discharges

Fracture of Vault or Base of Skull:
Between “800” and “80199”
Other Skull Fractures:
Between “803” and “80499”
Intra-cranial Injury, Concussion:
Between “850” and “85419”
Injury to Spinal Cord:
Between “9501” and “95039”
Head Injury, unspecified:
Like “95901*”
Shaken Infant Syndrome:
Like “99555*”

B. ICD-10, Deaths

Injuries to the head:

Between "S010" And "S0199" Or Between "S020" And "S0219"
Or Like "S023*" Or Between "S027" And "S0299" Or Like
"S040*" Or Between "S060" And "S0699" Or Like "S070*" Or
Like "S071*" Or Like "S078*" Or Like "S079*" Or Between
"S097" And "S0999"

Injuries involving multiple body regions:

Like "T010*" Or Like "T020*" Or Like "T040*" Or Like "T060*"

Sequelae of injuries to the head:

Like "T901*" Or Like "T902*" Or Like "T904*" Or Like "T905*"
Or Like "T908*" Or Like "T909*"

(The Like “_____*” is used in Microsoft Access coding to include the ICD code noted and all subsequent sub-codes in a group. The Between “_____” And “_____” statement includes all ICD codes in the range noted.)

III. Explanation of Tabulations

- *Occurrence*: For the purposes of the report, an occurrence can be described as an incident of traumatic brain injury in an individual.
- *Age*: In order to stabilize rates, this variable has been grouped into 10-year age groups.
- *Rate*: Rates are calculated using the estimated state population matching each year of data. Rates for aggregated years of data are calculated using aggregated years of estimated state population. All rates in this report are per 100,000 people.
- *Discharge Disposition*: Instances where the patient was admitted to the ED or Inpatient care with a Disposition coded as “Died” or “Is Null” were excluded so they would not be duplicated in the death data.
- *Data Suppression*: When there is a small number of events, which may lead to the ability to identify individual people, the data is suppressed to protect confidentiality. Rates are also suppressed if the estimate is too uncertain to be useful.
- *Data Aggregation*: Data aggregation groups the counts of events into age groups, groups of years, or groups of towns/counties, in order to improve the statistical significance of the rates, and/or to avoid the necessity of data suppression.

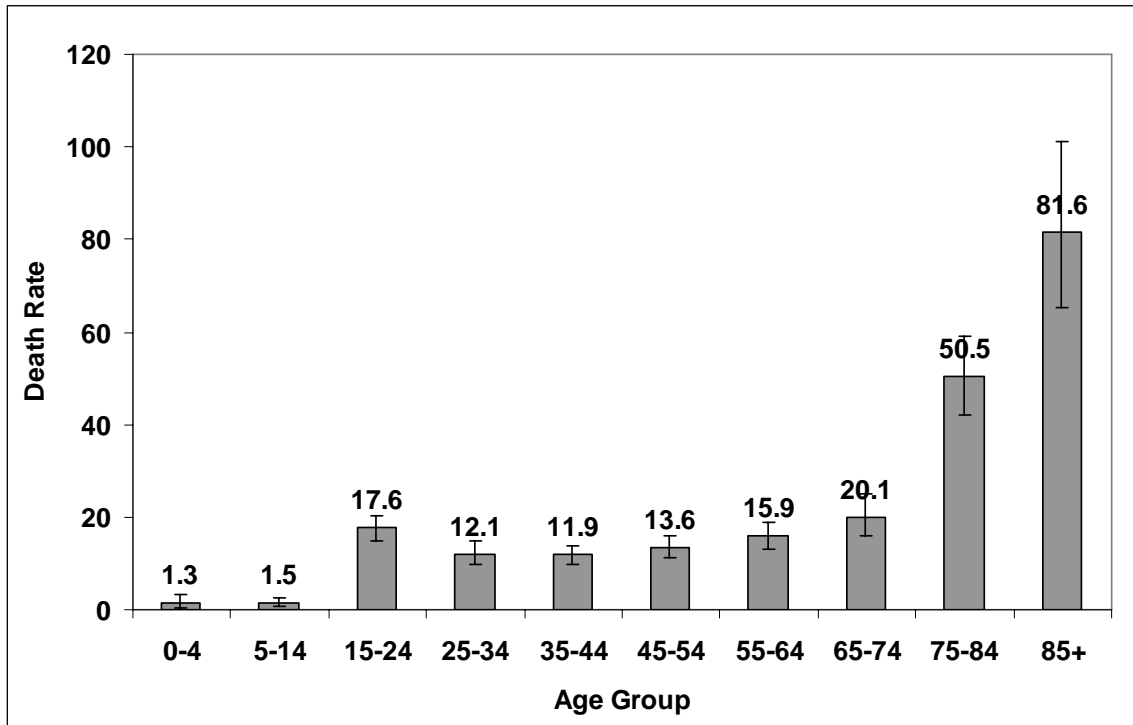
Mortality Rate, Traumatic Brain Injury by Age, 2001 to 2005

Table 2: TBI-Related Age-Specific Death Rates, 2001 – 2005

Age Group	Total	Age-Specific Rate	Lower 95% CI*	Upper 95% CI*
0 To 4	5	1.3	0.4	3.1
5 To 14	13	1.5	0.8	2.5
15 To 24	152	17.6	14.8	20.4
25 To 34	93	12.1	9.8	14.8
35 To 44	129	11.9	9.8	13.9
45 To 54	137	13.6	11.3	15.8
55 To 64	105	15.9	12.9	19.0
65 To 74	82	20.1	16.0	24.9
75 To 84	137	50.5	42.1	59.0
85 Plus	84	81.6	65.1	101.0
Total Crude Rate	937	14.6	13.6	15.5

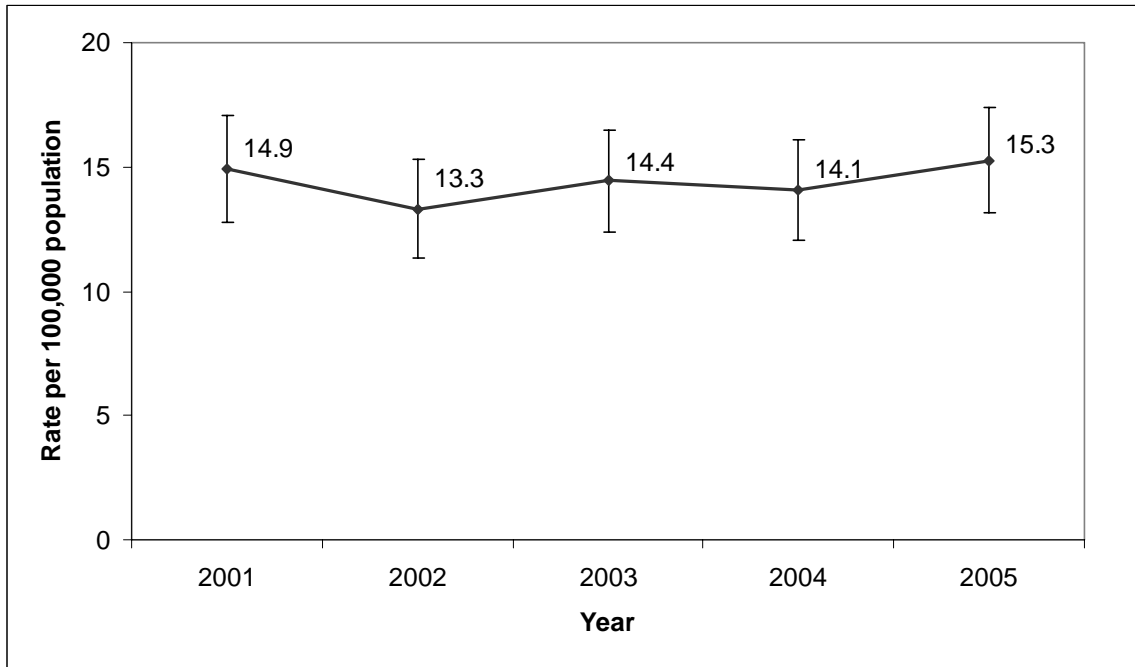
**CI = Confidence Interval*

Figure 1: TBI-Related Age-Specific Death Rates, 2001 – 2005



Between 2001 and 2005, the mortality rate for TBI-related deaths was highest in New Hampshire residents that are 75 years and older, and lowest in infants and children up to age 14.

Figure 2: NH Resident TBI-Related, Standardized Death Rates by Year, 2001-2005



There is no statistically significant difference in the rate of deaths for TBI between the years 2001 and 2005. The width of the confidence intervals overlaps across all years, showing the difference from year to year may be from chance.

Inpatient Hospital Discharges for TBI by Age, Occurrence and Rate

Table 3a: Inpatient Hospital Discharges for TBI, Occurrence by Age and Year, 2000-2005

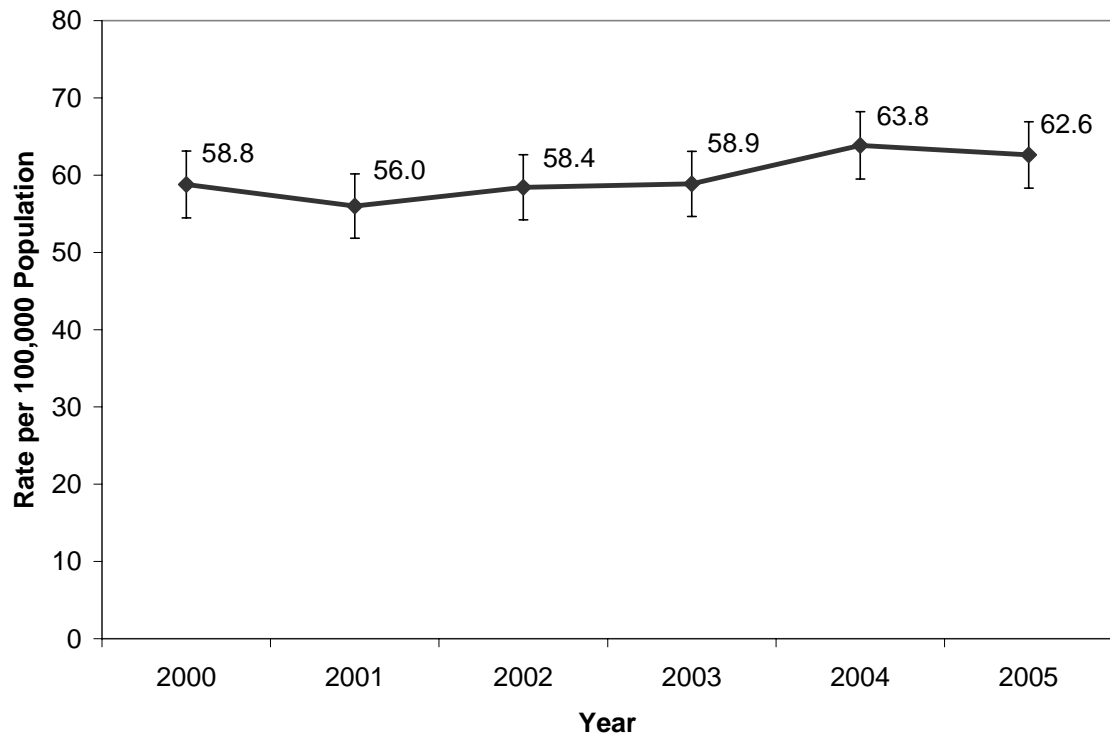
Age Group	2000	2001	2002	2003	2004	2005
0 To 4	26	32	25	26	19	21
5 To 14	40	49	41	41	55	44
15 To 24	131	120	113	129	131	143
25 To 34	64	66	72	68	85	65
35 To 44	96	113	97	93	96	81
45 To 54	81	72	99	92	87	97
55 To 64	65	45	63	66	88	81
65 To 74	69	65	70	73	89	82
75 To 84	85	72	100	99	113	122
85 Plus	58	61	61	70	68	95
Total	715	695	741	757	831	831

Table 3b: Inpatient Hospital Discharges for TBI, Standardized Rate by Year, 2000-2005

Year	Count	Inpatient Rate per 100,000	Lower 95% CI* Standardized Rate	Upper 95% CI* Standardized Rate
2000	715	58.8	54.5	63.1
2001	695	56.0	51.8	60.2
2002	741	58.4	54.2	62.6
2003	757	58.9	54.7	63.1
2004	831	63.8	59.5	68.2
2005	831	62.6	58.3	66.9

**CI = Confidence Interval*

Figure 3: Inpatient Hospital Discharges, Standardized Rate by Year, 2000-2005



There is no statistically significant difference in the rate of inpatient discharges for TBI between the years 2000 and 2005. Although the rate appears to increase in the latter years, the width of the confidence intervals overlaps across all years, showing the difference from year to year may be from chance.

Emergency Department (ED) Discharges for TBI by Age, Occurrence and Rate

Table 4a: Emergency Department Discharges for TBI, Occurrence by Age and Year, 2000-2005

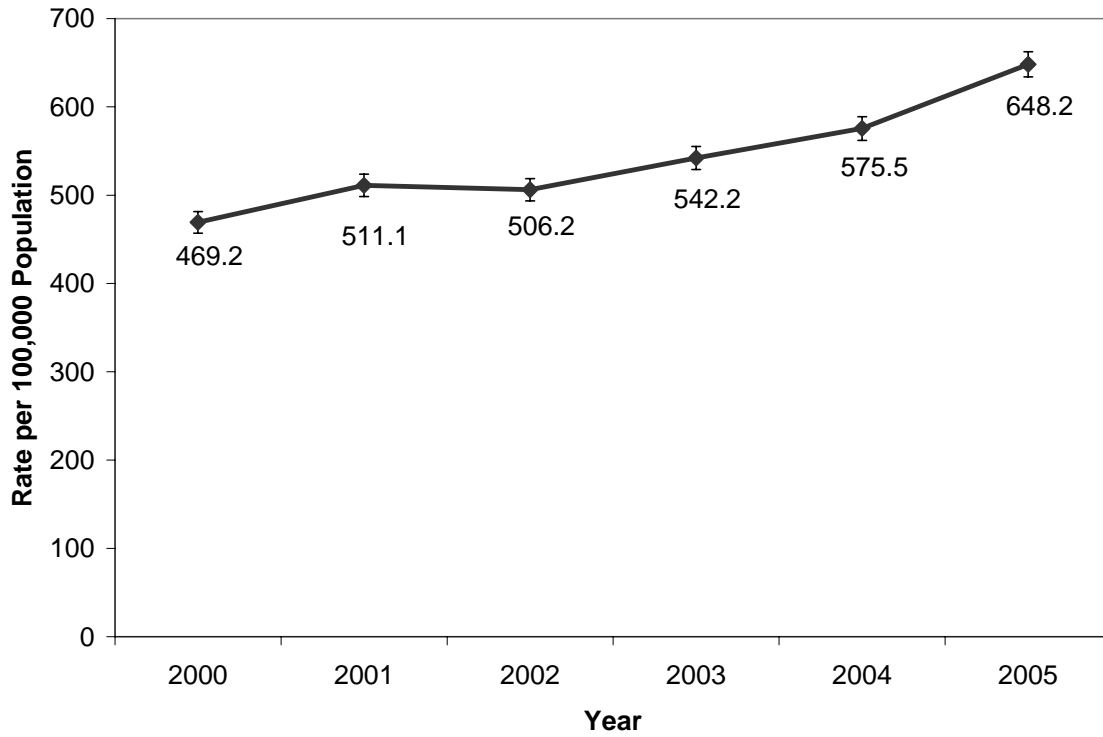
Age Group	2000	2001	2002	2003	2004	2005
0 To 4	677	816	776	803	807	867
5 To 14	1030	1091	1063	1052	1160	1249
15 To 24	1409	1451	1532	1677	1849	2040
25 To 34	708	738	772	761	801	912
35 To 44	712	778	770	842	816	905
45 To 54	404	486	523	541	584	708
55 To 64	194	245	243	348	410	435
65 To 74	164	207	186	267	251	310
75 To 84	222	235	237	289	335	442
85 Plus	123	182	134	170	212	333
Total	5643	6229	6236	6750	7225	8201

Table 4b: Emergency Department Discharges for TBI, Standardized Rate by Year, 2000-2005

Year	Count	ED Rate per 100,000	Lower 95% CI* Standardized Rate	Upper 95% CI* Standardized Rate
2000	5643	469.2	456.9	481.5
2001	6229	511.1	498.4	523.8
2002	6236	506.2	493.6	518.8
2003	6750	542.2	529.2	555.2
2004	7225	575.5	562.2	588.9
2005	8201	648.2	634.1	662.3

**CI = Confidence Interval*

Figure 4: Standardized Rates for TBI ED Discharges, 2000-2005



There is a statistically significant difference in the rate of ED discharges for TBI between the years 2000 and 2005. The rates increase between years 2002 and 2005, and the confidence intervals do not overlap.

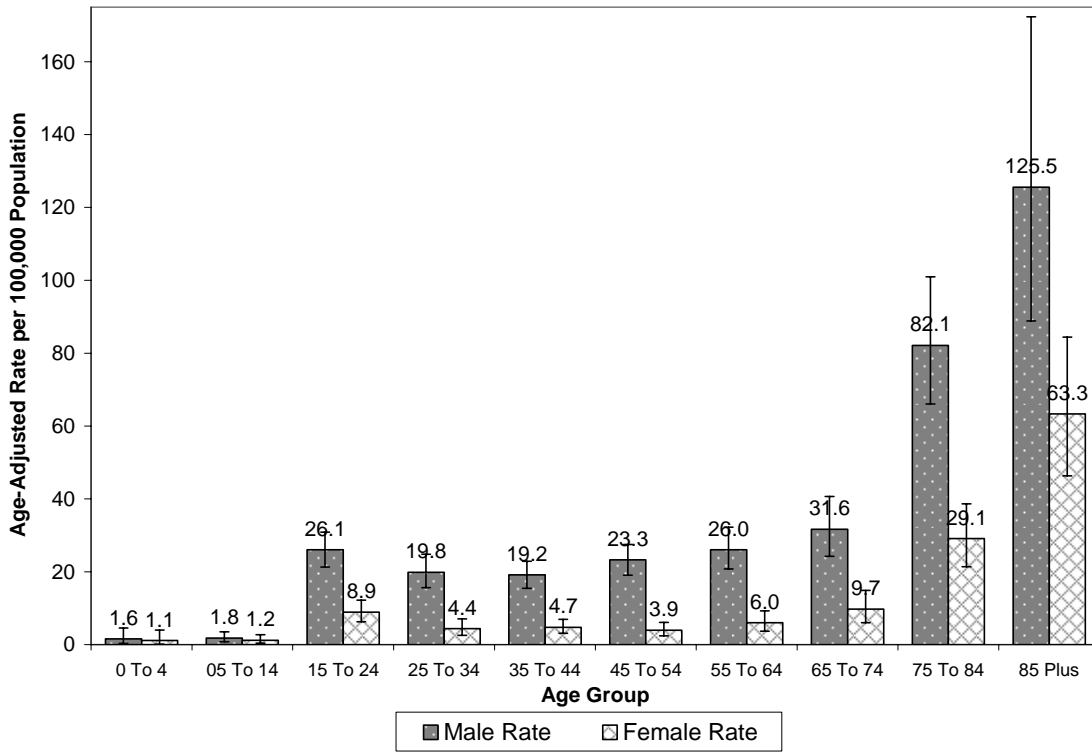
TBI Mortality by Age Group and Gender

Table 5: TBI-Related Death Rates by Age Group and Gender, 2001 – 2005

Age Groups	Standardized Rate	Lower 95% CI*	Upper 95% CI*	Standardized Rate	Lower 95% CI*	Upper 95% CI*
	Male	Male	Male	Female	Female	Female
	Male	Male	Male	Female	Female	Female
0 To 4	1.6	0.3	4.6	1.1	0.1	4.0
5 To 14	1.8	0.8	3.5	1.2	0.4	2.7
15 To 24	26.1	21.3	30.9	8.9	6.3	12.2
25 To 34	19.8	15.6	24.8	4.4	2.6	7.1
35 To 44	19.2	15.5	22.9	4.7	3.1	6.9
45 To 54	23.3	19.1	27.5	3.9	2.4	6.1
55 To 64	26.0	20.8	32.2	6.0	3.7	9.3
65 To 74	31.6	24.2	40.6	9.7	6.0	14.9
75 To 84	82.1	66.0	101.0	29.1	21.4	38.7
85 Plus	125.5	88.8	172.3	63.3	46.3	84.4

**CI = Confidence Interval*

Figure 5: TBI-Related Death Rates by Age Group and Gender, 2001 – 2005



Among all TBI-related deaths, the rate of incidence per 100,000 males is significantly higher than the rate for females across all age groups, during year 2001-2005. There is little statistically significant difference within genders and between age groups until age 75 and older, where there is a noted increase in TBI deaths in both females and males.

Inpatient Hospital Discharges for TBI by Age and Gender, Occurrence and Rate

Table 6a: Occurrence of Inpatient Hospital Discharges for TBI by Age and Gender, 2000-2005

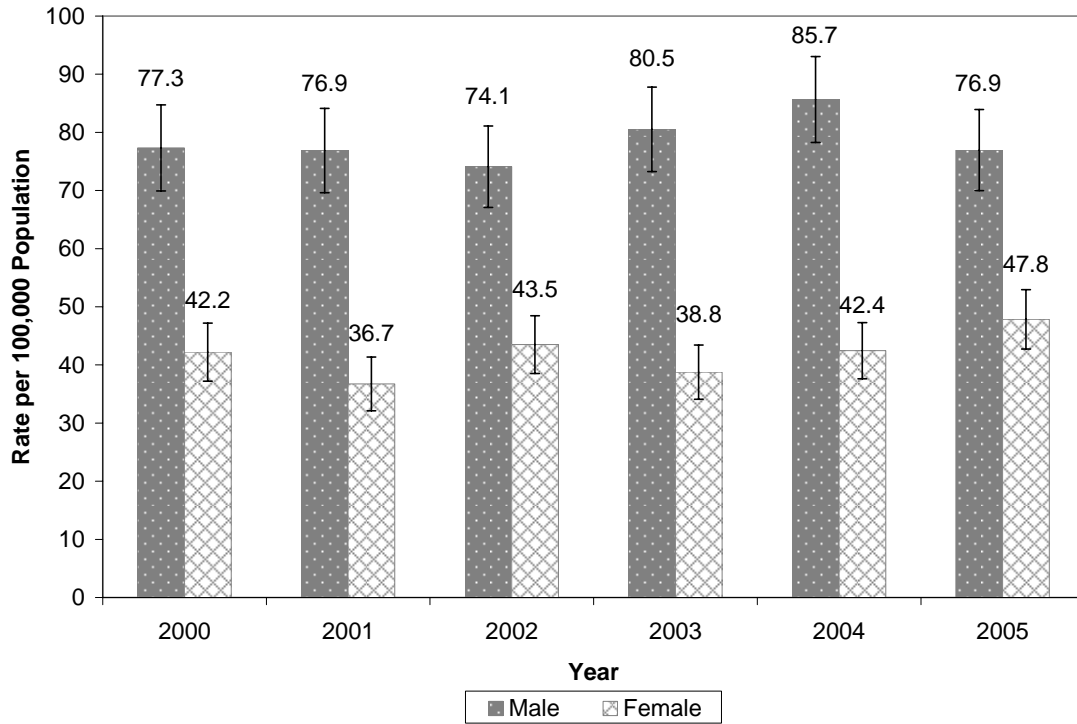
Age Group	Gender	2000	2001	2002	2003	2004	2005
0 To 4	F	12	14	11	6	6	14
5 To 14	F	15	15	13	10	19	13
15 To 24	F	36	30	28	43	34	35
25 To 34	F	15	16	22	14	19	22
35 To 44	F	34	31	38	30	23	18
45 To 54	F	35	23	38	21	41	37
55 To 64	F	22	18	23	27	18	30
65 To 74	F	30	23	28	29	27	38
75 To 84	F	42	39	58	47	69	72
85 Plus	F	36	37	40	45	46	70
0 To 4	M	14	18	14	20	13	7
5 To 14	M	25	34	28	31	36	31
15 To 24	M	95	90	85	86	97	108
25 To 34	M	49	50	50	54	66	43
35 To 44	M	62	82	59	63	73	63
45 To 54	M	46	49	61	71	46	60
55 To 64	M	43	27	40	39	70	51
65 To 74	M	39	42	42	44	62	44
75 To 84	M	43	33	42	52	44	50
85 Plus	M	22	24	21	25	22	25

Table 6b: Standardized Rate of Inpatient Hospital Discharges for TBI by Gender, 2000-2005

	Standardized Rate	Lower 95% CI*	Upper 95% CI*	Standardized Rate	Lower 95% CI*	Upper 95% CI*
Year	Male	Male	Male	Female	Female	Female
2000	77.3	69.9	84.7	42.2	37.2	47.2
2001	76.9	69.6	84.1	36.7	32.1	41.4
2002	74.1	67.1	81.1	43.5	38.5	48.5
2003	80.5	73.2	87.8	38.8	34.1	43.4
2004	85.7	78.3	93.1	42.4	37.6	47.3
2005	76.9	70.0	83.9	47.8	42.7	53.0

**CI = Confidence Interval*

Figure 6: Standardized Rate of Inpatient Hospital Discharges for TBI by Gender, 2000-2005



Between 2000 and 2005, the rates of male inpatient discharges for TBI were significantly higher than female rates. From year to year, there is not a significant difference within the male group or the female group. As the chart above shows, the confidence intervals overlap within the gender groups.

ED Hospital Discharges for TBI by Age and Gender, Occurrence and Rate
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Table 7a: Occurrence of ED Hospital Discharges for TBI by Age and Gender, 2000-2005

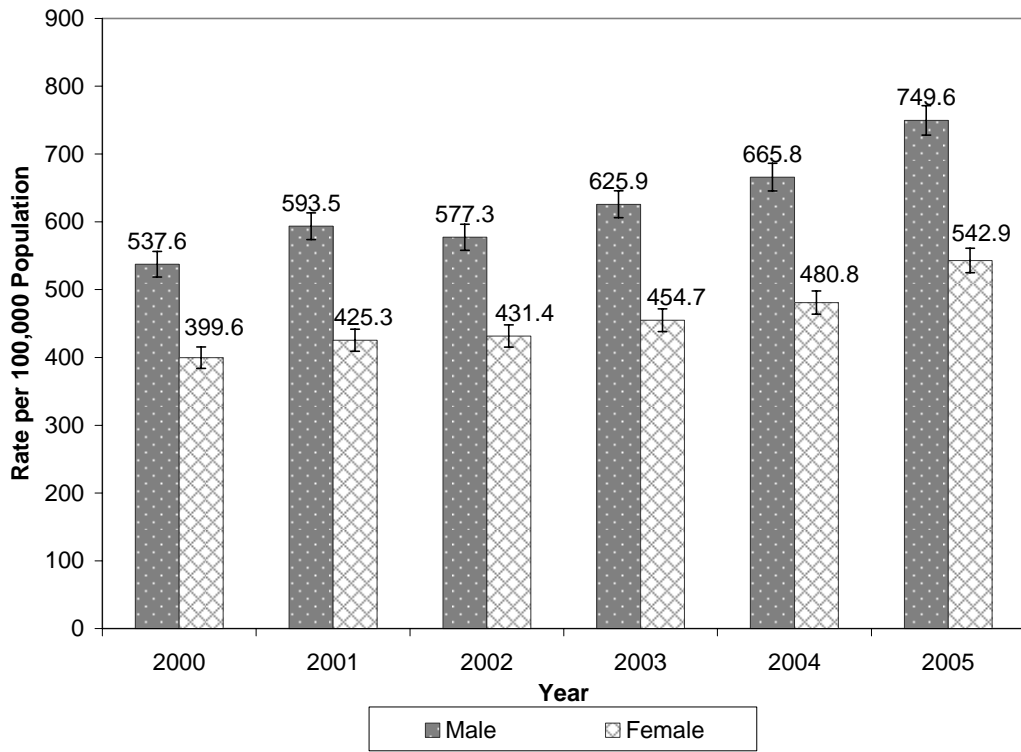
Age Group	Gender	2000	2001	2002	2003	2004	2005
0 To 4	F	298	332	306	337	340	370
5 To 14	F	367	342	373	357	375	382
15 To 24	F	543	566	610	636	724	798
25 To 34	F	280	299	327	310	317	384
35 To 44	F	338	360	374	387	364	406
45 To 54	F	207	240	260	232	282	338
55 To 64	F	107	113	117	187	206	202
65 To 74	F	85	120	96	143	122	164
75 To 84	F	138	151	148	182	217	266
85 Plus	F	86	131	102	125	154	236
0 To 4	M	379	484	470	466	467	497
5 To 14	M	663	749	690	695	785	867
15 To 24	M	866	885	922	1041	1125	1242
25 To 34	M	428	439	445	451	484	528
35 To 44	M	374	418	396	455	452	499
45 To 54	M	197	246	263	309	302	370
55 To 64	M	87	132	126	161	204	233
65 To 74	M	79	87	90	124	129	146
75 To 84	M	84	84	89	107	118	176
85 Plus	M	37	51	32	45	58	97

Table 7b: Standardized Rate of ED Hospital Discharges for TBI by Gender, 2000-2005

	Standardized Rate	Lower 95% CI*	Upper 95% CI*	Standardized Rate	Lower 95% CI*	Upper 95% CI*
Year	Male	Male	Male	Female	Female	Female
2000	537.6	518.8	556.3	399.6	383.6	415.5
2001	593.5	573.9	613.1	425.3	409.0	441.6
2002	577.3	558.1	596.5	431.4	415.1	447.8
2003	625.9	606.0	645.7	454.7	438.0	471.4
2004	665.8	645.4	686.3	480.8	463.7	497.9
2005	749.6	727.9	771.3	542.9	524.8	561.0

**CI = Confidence Interval*

Figure 7: Standardized Rate of ED Hospital Discharges for TBI by Gender, 2000-2005



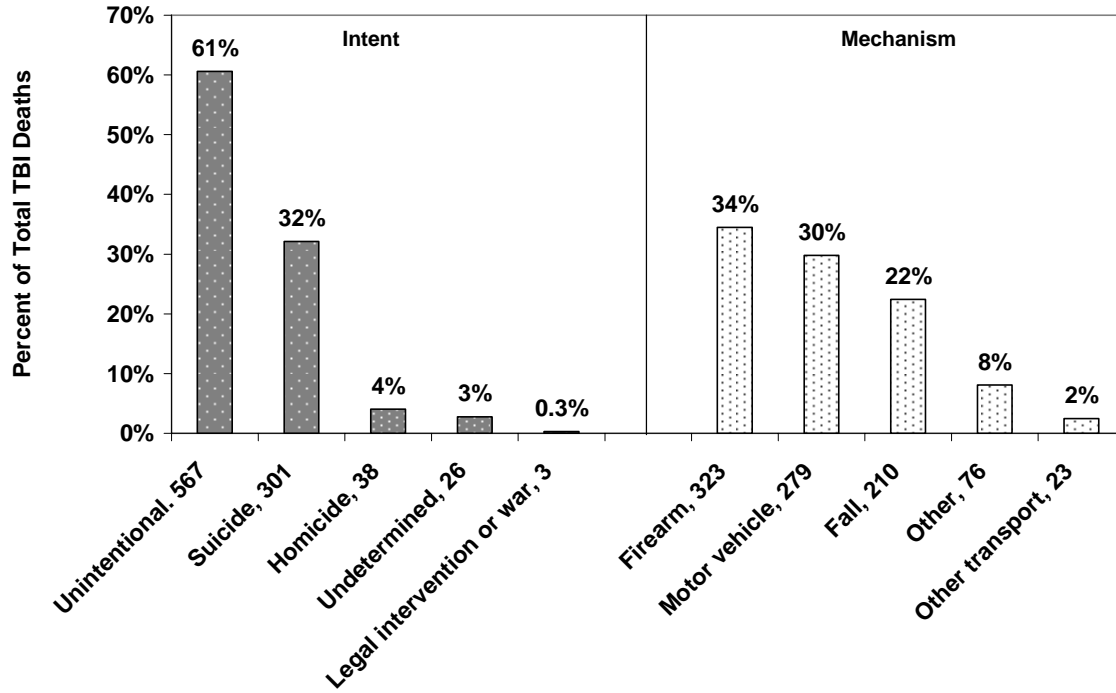
Like the Inpatient discharge data, between 2000 and 2005, the rates of male ED discharges for TBI were significantly higher than female rates. Unlike the Inpatient discharge data, in the later years there is a significant difference within the male group and the female group. As the chart above shows, the confidence intervals do not overlap within the gender groups in the years 2004 and 2005 showing an increase in rates of ED discharges from 2004 to 2005.

TBI Mortality by Mechanism, 2001-2005

Table 8: TBI Mortality by Mechanism and Intent

Mechanism of TBI-Related Death	Adverse effects	Homicide	Legal intervention or war	Suicide	Undetermined	Unintentional	Total	Percent of Mechanisms of Death
Firearm		20	2	293	1	7	323	34.5%
Motor vehicle		1		1		277	279	29.8%
Fall				6	2	202	210	22.4%
Other		14	1	1	23	37	76	8.1%
Other transport						23	23	2.5%
Struck by or against		2				6	8	0.9%
Pedestrian						6	6	0.6%
Machinery						4	4	0.4%
Natural/environment						3	3	0.3%
Drowning						2	2	0.2%
Pedal cyclist						1	1	0.1%
Cut/pierce		1					1	0.1%
Adverse effects	1						1	0.1%
Total	1	38	3	301	26	568	937	
Percent of Total Intent	0.1	4.1	0.3	32.1	2.8	60.6		

Figure 8: Top 5 TBI-Related Deaths by Intent and Top 5 TBI-Related Deaths by Mechanism, 2001-2005



Most TBI-related deaths are unintentional or accidental (61%), followed by suicide (32%). The mechanism of most accidental TBI deaths are from motor vehicle crashes or falls, and the mechanism of most suicide TBI deaths are from firearms.

TBI Inpatient Hospital Discharges by Mechanism, 2000-2005

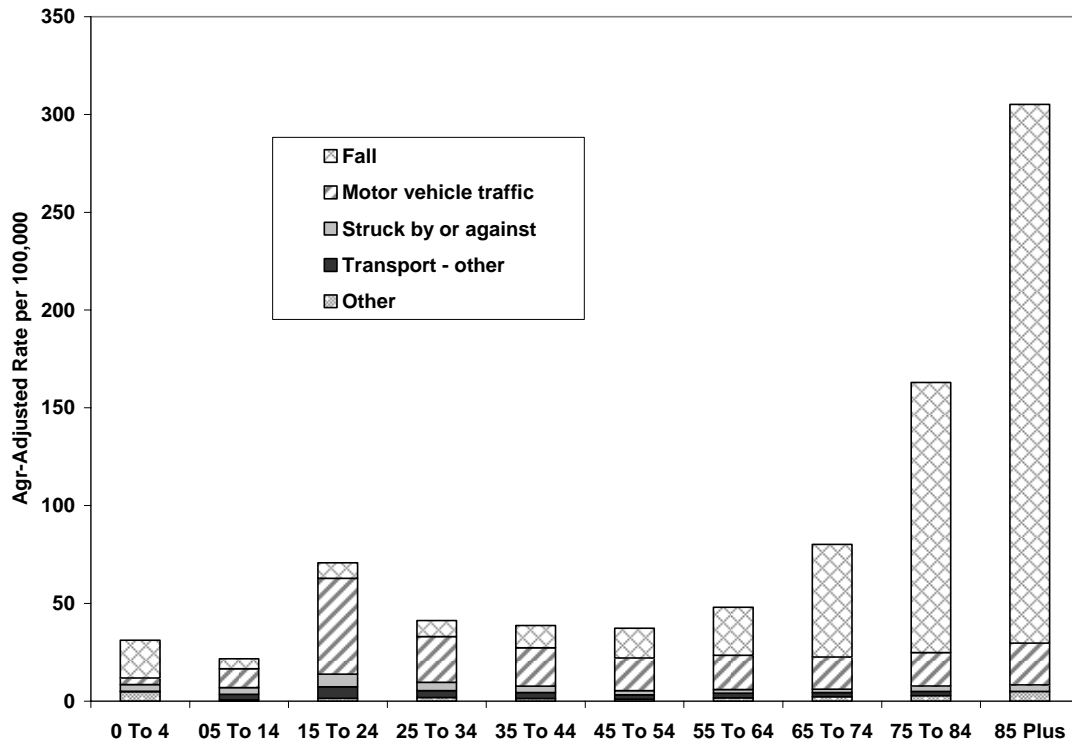
Table 9a: TBI Inpatient Discharges by Mechanism and Year 2000-2005

Mechanism	2000	2001	2002	2003	2004	2005	Total	Percent
Fall	292	273	286	315	340	371	1877	44%
Motor vehicle traffic	242	249	258	253	307	282	1591	37%
Struck by or against	32	43	46	51	45	44	261	6%
Transport - other	39	42	28	31	46	39	225	5%
Other	18	22	25	25	18	21	129	3%
Pedal cyclist	27	16	13	17	11	13	97	2%
Adverse effects	10	6	13	7	8	8	52	1%
Firearm	2	2	3	4	1	2	14	0.3%
Poisoning	6		1	3	3	1	14	0.3%
Cut/pierce		1	5	2	1	1	10	0.2%
Pedestrian	1		3	1	1	3	9	0.2%
Machinery	2		1	2	1	2	8	0.2%
Natural/environmental				3	4	1	8	0.2%
Drowning/submersion					1		1	0.02%
Fire or hot object/substance	1						1	0.02%
Suffocation						1	1	0.02%
Total	672	654	682	714	787	789	4298	100%

Table 9b: Age-Adjusted Rate of TBI Inpatient Discharges by Mechanism, 2000-2005 (rates based on fewer than 20 total events excluded)

Age Group	Adverse effects	Fall	Motor vehicle traffic	Other	Pedal cyclist	Struck by or against	Transport - other
0 To 4	0.0	19.3	3.3	4.9	0.0	3.3	0.2
5 To 14	0.2	5.1	9.6	0.7	2.9	3.5	2.8
15 To 24	0.7	7.9	49.1	1.5	1.4	6.4	5.9
25 To 34	0.3	8.2	23.5	1.8	0.3	4.2	3.6
35 To 44	0.5	11.3	19.7	1.4	1.0	3.3	3.0
45 To 54	0.2	15.2	16.7	0.9	1.7	2.2	2.3
55 To 64	0.5	24.4	17.7	1.7	0.9	1.8	2.3
65 To 74	0.8	57.7	16.4	2.3	1.8	1.8	2.1
75 To 84	4.3	138.2	17.0	2.8	0.0	2.8	2.2
85 Plus	8.2	275.5	21.4	4.9	0.0	3.3	0.0

Figure 9a: Top 5 Age-Adjusted Rates of Inpatient Discharges by Mechanism, 2000-2005 (rates based on fewer than 20 total events excluded)



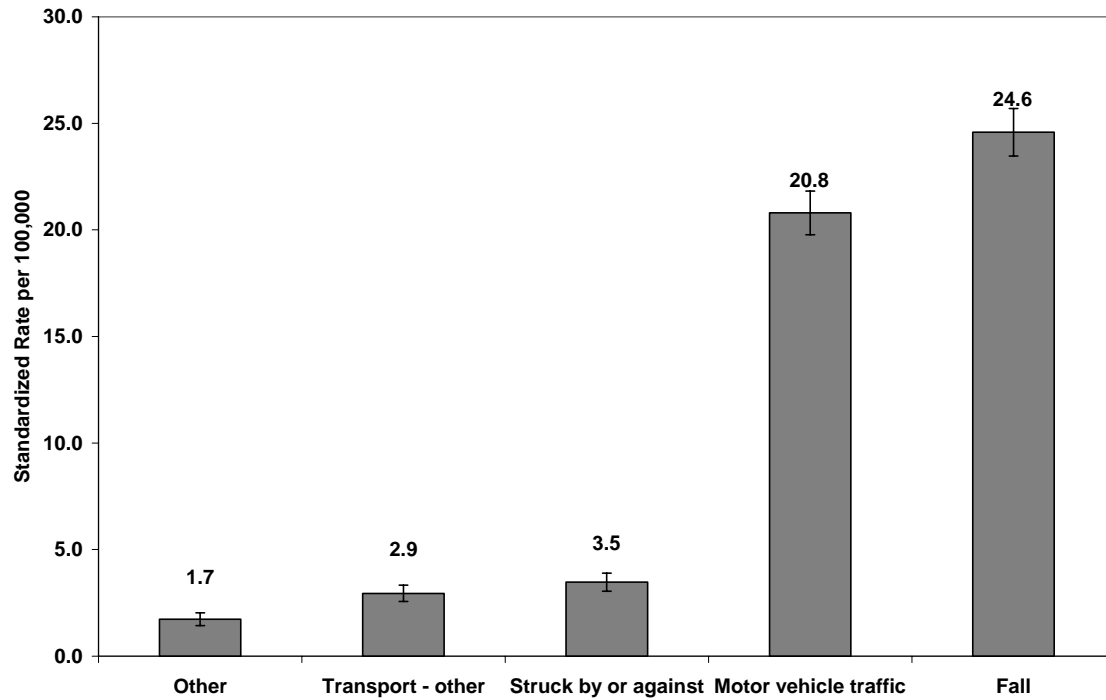
The age-adjusted rates for mechanisms, or causes of injury, for TBI Inpatient discharges identify falls as the most common cause, followed by motor vehicle crashes. Ages 65 and older are most likely to have a hospital stay for TBI from falls, and ages 15 to 24 are more likely to have a hospital stay for TBI from a motor vehicle crash.

**Table 9c: Standardized Rate of Inpatient Discharges by Mechanism, 2000-2005
(rates based on fewer than 20 total events excluded)**

Mechanism	Count	Standardized Rate	Lower 95% CI* Standardized Rate	Upper 95% CI* Standardized Rate
Fall	1,877	24.6	23.5	25.7
Motor vehicle traffic	1,591	20.8	19.8	21.8
Struck by or against	261	3.5	3.0	3.9
Transport - other	225	2.9	2.6	3.3
Other	129	1.7	1.4	2.0
Pedal cyclist	97	1.2	1.0	1.5
Adverse effects	52	0.7	0.5	0.9

**CI = Confidence Interval*

Figure 9b: Top 5 Standardized Rates of Inpatient Discharges by Mechanism, 2000-2005 (rates based on fewer than 20 total events excluded)



TBI Emergency Department Hospital Discharges by Mechanism

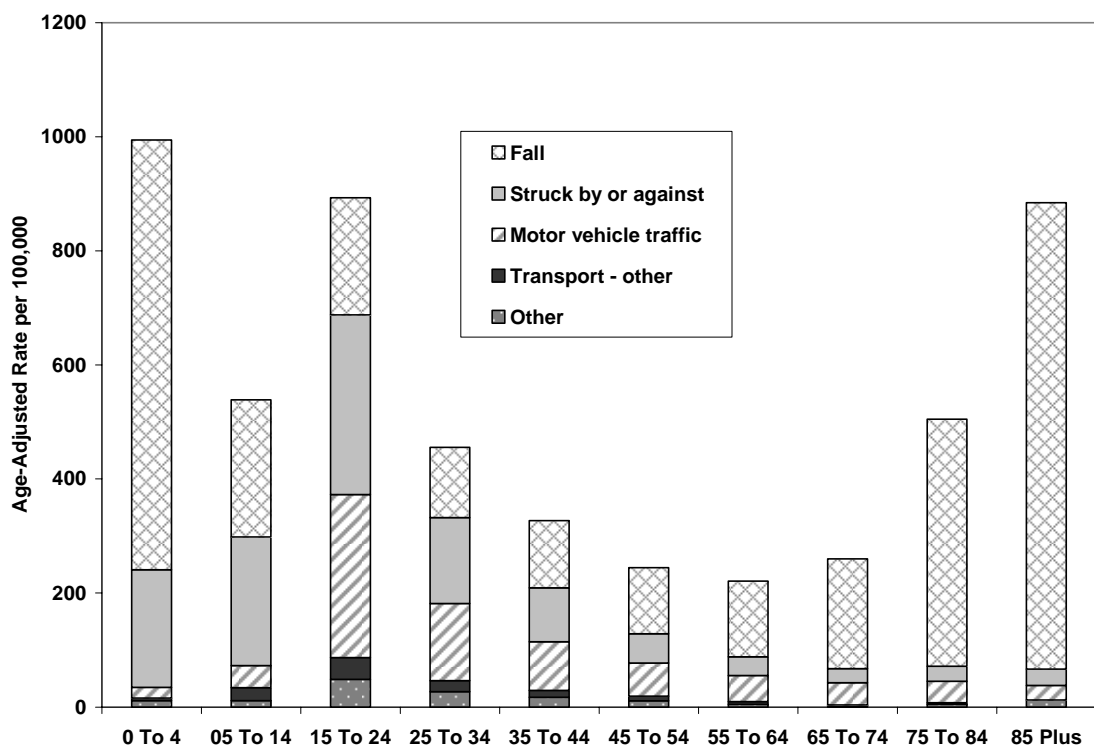
**Table 10a: Emergency Department Discharges for TBI by Mechanism and Year
2000-2005**

Mechanism	2000	2001	2002	2003	2004	2005	Total	Percent
Fall	2,059	2,504	2,596	2,806	3,009	3,494	16,468	43.2%
Struck by or against	1,469	1,590	1,598	1,719	1,845	2,077	10,298	27.0%
Motor vehicle traffic	1,036	1,050	1,084	1,240	1,315	1,446	7,171	18.8%
Other	189	227	213	225	226	292	1,372	3.6%
Transport - other	150	190	172	194	219	221	1,146	3.0%
Pedal cyclist	209	165	174	168	202	195	1,113	2.9%
Cut/pierce	17	24	26	28	43	46	184	0.5%
Natural/environmental	15	13	21	11	25	24	109	0.3%
Machinery	6	10	6	12	14	14	62	0.2%
Overexertion	7	10	8	5	8	10	48	0.1%
Pedestrian	7	7	5	5	7	3	34	0.1%
Adverse effects	2	10	6	2	2	4	26	0.1%
Drowning/submersion	1	3	4	6	1	6	21	0.1%
Poisoning	1	5	2	4	5	4	21	0.1%
Fire or hot object/substance			1	4	5	1	11	0.03%
Firearm		4		2	1	3	10	0.03%
Suffocation	2	1	1			2	6	0.02%
Total	5,170	5,813	5,917	6,431	6,927	7,842	38,100	100%

Table 10b: Age-Adjusted Rate of Emergency Department Discharges for TBI by Mechanism, 2000-2005 (rates based on fewer than 20 total events excluded)

Age Group	Adverse Effects	Cut/pierce	Drowning/submersion	Fall	Machinery	Motor vehicle traffic	Natural/environmental	Other	Overexertion	Pedal cyclist	Pedestrian	Poisoning	Struck by or against	Transport - other
0 To 4	0.4	6.0	0.0	753.3	0.0	18.9	2.0	11.3	0.7	11.6	0.9	0.2	206.1	4.7
5 To 14	0.0	2.4	0.5	240.5	0.2	38.6	1.8	11.4	0.8	57.7	1.0	0.3	225.6	22.7
15 To 24	0.7	4.3	0.6	205.4	1.2	286.0	2.0	48.6	1.5	21.1	0.4	0.3	314.9	38.3
25 To 34	0.2	4.4	0.4	123.1	1.5	135.1	1.3	26.8	0.8	5.6	0.5	0.3	150.9	19.7
35 To 44	0.1	1.3	0.2	117.7	1.6	84.9	1.5	17.4	0.6	6.8	0.5	0.5	94.9	12.1
45 To 54	0.3	1.1	0.2	115.7	0.9	58.2	1.7	10.9	0.2	4.4	0.2	0.2	51.4	8.2
55 To 64	0.3	0.9	0.1	132.8	0.3	45.5	0.8	5.1	0.4	2.3	0.0	0.1	33.0	4.7
65 To 74	0.8	1.0	0.0	192.9	0.0	39.2	0.4	2.3	0.2	3.3	0.2	0.0	24.2	1.6
75 To 84	0.6	0.9	0.0	433.1	0.0	37.5	0.3	5.0	0.0	0.6	0.3	0.0	26.3	2.8
85 Plus	1.6	0.8	0.0	817.5	0.0	25.6	0.8	12.4	0.0	0.8	0.0	1.6	28.9	0.0

Figure 10a: Top 5 Age-Adjusted Rates of Emergency Department Discharges for TBI by Mechanism, 2000-2005 (rates based on fewer than 20 total events excluded)



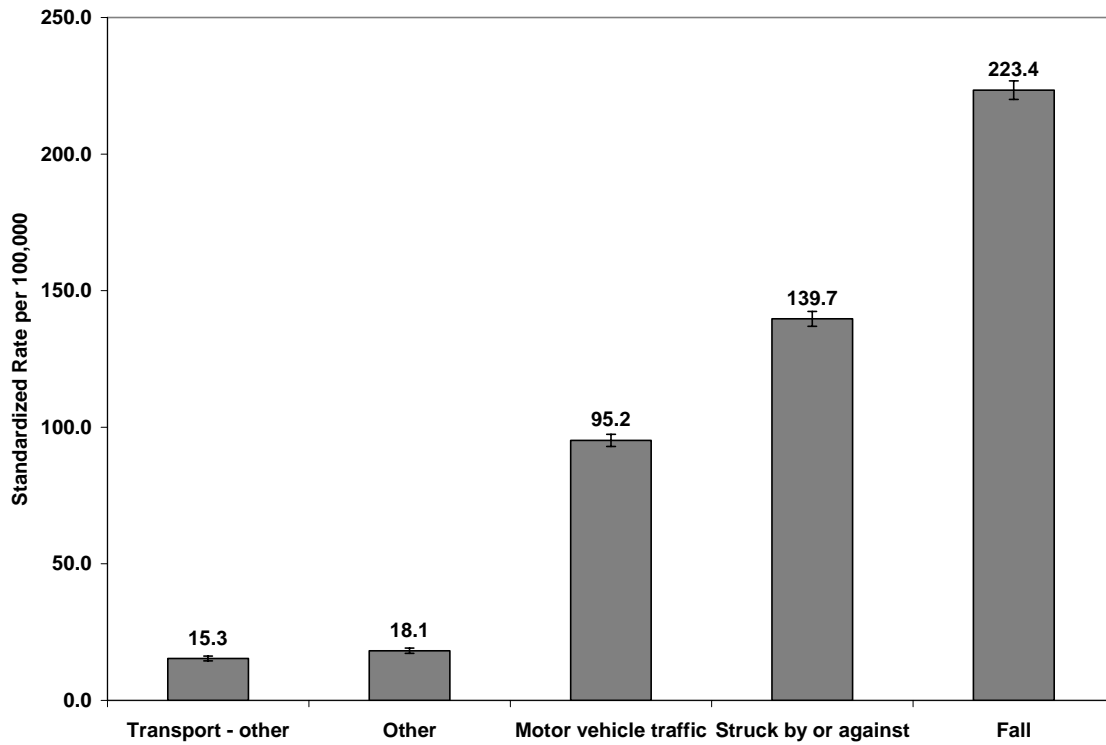
Most ED discharges for TBI are for falls by young children (ages 0 to 4) and elderly (ages 75 and older). The second most common TBI ED discharges are for being “struck by or against” in ages 0 to 24 years, followed by motor vehicle crashes in the 15 to 24 year old age group.

Table 10c: Standardized Rate of Emergency Department Discharges for TBI by Mechanism, 2000-2005 (rates based on fewer than 20 total events excluded)

Mechanism	Count	Standardized Rate	Lower 95% CI* Standardized Rate	Upper 95% CI* Standardized Rate
Fall	16,468	223.4	220.0	226.8
Struck by or against	10,298	139.7	137.0	142.4
Motor vehicle traffic	7,171	95.2	93.0	97.4
Other	1,357	18.1	17.2	19.1
Transport - other	1,146	15.3	14.4	16.2
Pedal cyclist	1,113	15.0	14.1	15.9
Cut/pierce	184	2.5	2.2	2.9
Natural/environmental	109	1.4	1.2	1.7
Machinery	62	0.8	0.6	1.0
Overexertion	48	0.6	0.5	0.9
Pedestrian	34	0.5	0.3	0.6
Adverse Effects	26	0.3	0.2	0.5
Drowning/submersion	21	0.3	0.2	0.4
Poisoning	21	0.3	0.2	0.4

**CI = Confidence Interval*

Figure 10b: Standardized Rate of Emergency Department Discharges by Mechanism, 2000-2005 (rates base on fewer than 20 total events excluded)



Inpatient Discharges for TBI Occurrences by Diagnosis

NOTE: The total numbers here are slightly higher than the total count of patients because some patients had more than one type of head injury. These data have been deduplicated as much as possible.

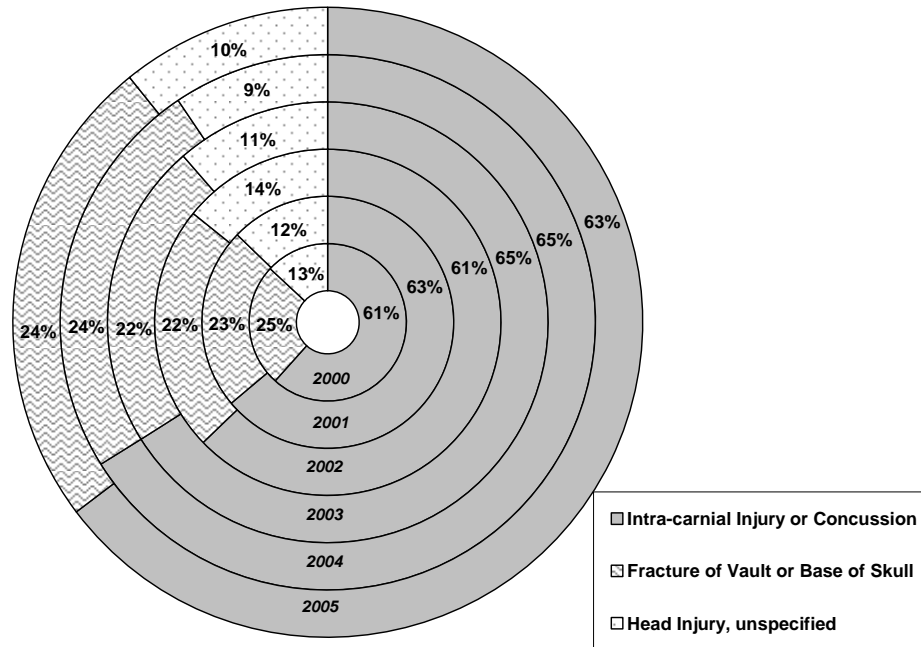
Table 11a: Count of Inpatient Discharges, TBI Occurrences by Diagnosis, across principle diagnosis and all secondary diagnosis fields, 2000-2005

TBI Diagnosis	2000	2001	2002	2003	2004	2005	Total
Fracture of Vault or Base of Skull	180	162	166	171	203	203	1085
Head Injury, unspecified	94	88	104	86	78	89	539
Intra-cranial Injury or Concussion	441	442	458	502	547	537	2927
Other Skull Fractures	11	11	16	12	14	24	88
Shaken Infant Syndrome	2	2	4	2		1	11
Total	728	705	748	773	842	854	4650

Table 11b: Percent of Inpatient Discharges, TBI Occurrences by Diagnosis, across principle diagnosis and all secondary diagnosis fields, 2000-2005

TBI Diagnosis	2000	2001	2002	2003	2004	2005	Total
Fracture of Vault or Base of Skull	25%	23%	22%	22%	24%	24%	23%
Head Injury, unspecified	13%	12%	14%	11%	9%	10%	12%
Intra-cranial Injury or Concussion	61%	63%	61%	65%	65%	63%	63%
Other Skull Fractures	2%	2%	2%	2%	2%	3%	2%
Shaken Infant Syndrome	0%	0%	1%	0%	0%	0%	0%

Figure 11: Top 3 Percent of Inpatient Discharges, TBI Occurrences by Diagnosis, across principle diagnosis and all secondary diagnosis fields, 2000-2005



The chart above clearly shows the highest percent of total Inpatient discharges with TBI diagnoses are for Intra-Cranial Concussion (61% to 65%), followed by Fracture of the Vault or Base of Skull (22% to 29%), and lastly unspecified head injury, (9% to 14%). The annual numbers for other skull fractures and shaken infant syndrome are too small to generate statistically significant information.

Emergency Department Discharges for TBI Occurrences by Diagnosis

NOTE: The total numbers here are slightly higher than the total count of patients because some patients had more than one type of head injury. These data have been deduplicated as much as possible.

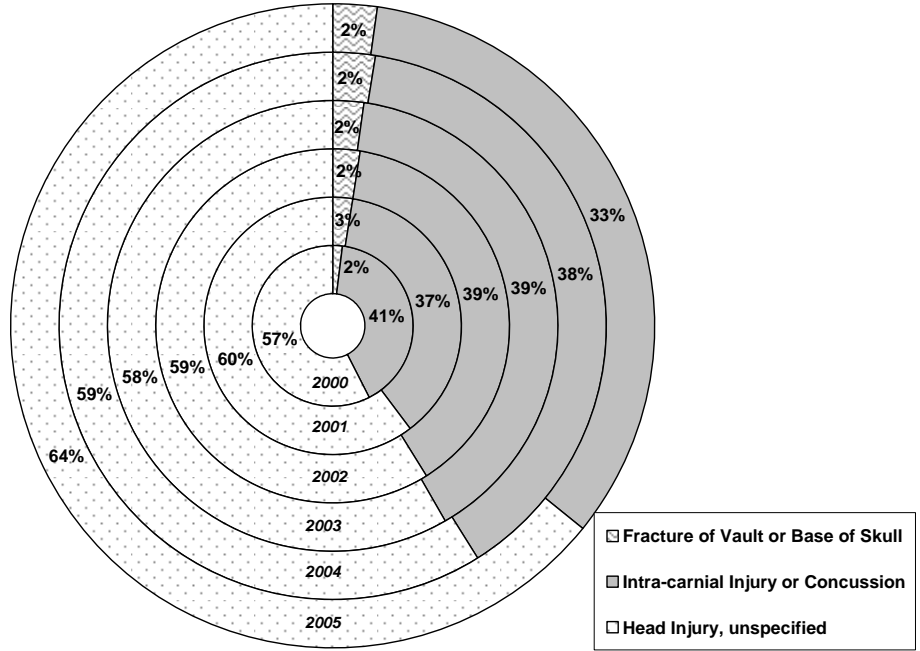
Table 12a: Count of ED Discharges, TBI Occurrences by Diagnosis, across principle diagnosis and all secondary diagnosis fields, 2000-2005

TBI Diagnosis	2000	2001	2002	2003	2004	2005	Total
Head Injury, unspecified	3276	3824	3739	3981	4346	5329	24495
Intra-cranial Injury or Concussion	2323	2349	2459	2700	2837	2789	15457
Fracture of Vault or Base of Skull	105	160	151	155	182	195	948
Other Skull Fractures	27	20	20	29	29	34	159
Shaken Infant Syndrome	0	0	3	2	1	2	8
Total	5731	6353	6372	6867	7395	8349	41067

Table 12b: Percent of ED Discharges, TBI Occurrences by Diagnosis, across principle diagnosis and all secondary diagnosis fields, 2000-2005

TBI Diagnosis	2000	2001	2002	2003	2004	2005	Total
Head Injury, unspecified	57%	60%	59%	58%	59%	64%	60%
Intra-cranial Injury or Concussion	41%	37%	39%	39%	38%	33%	38%
Fracture of Vault or Base of Skull	2%	3%	2%	2%	2%	2%	2%
Other Skull Fractures	0.5%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%
Shaken Infant Syndrome	0.00%	0.00%	0.05%	0.03%	0.01%	0.02%	0.02%

Figure 12: Percent of ED Discharges, TBI Occurrences by Diagnosis, across principle diagnosis and all secondary diagnosis fields, 2000-2005



ED discharges with TBI diagnoses are different than Inpatient discharges. Head injuries, unspecified are the largest category. This may be due to insufficient detail in the medical record resulting in a large number of diagnoses being coded in the unspecified category. Again, the annual numbers for other skull fractures and shaken infant syndrome are too small to generate statistically significant information.

Inpatient Discharges for TBI Occurrences by Disposition

NOTE: The validity of disposition data is questionable because no data is available to confirm that these events occurred after the patient was discharged.

Table 13: Inpatient Discharges for TBI Occurrences by Disposition and Year, 2000-2005

Disposition	2000	2001	2002	2003	2004	2005	Total	Percent
Home THEN Self Care	388	389	394	411	431	414	2427	53%
Skilled Nursing Facility	89	79	95	103	99	127	592	13%
Home Health Service	83	74	100	90	117	107	571	12%
Transfer To Rehabilitation Facility	64	48	57	63	89	72	393	9%
Transfer To Rehab. In Acute Facility	30	39	31	33	28	44	205	4%
Other Short Term Hospital	24	29	30	27	23	26	159	3%
Structured/Assisted Living	11	12	10	5	12	15	65	1%
Against Medical Advice	10	8	5	10	9	10	52	1%
Intermediate Care Facility	5	6	9	6	9	7	42	1%
Other or Unknown	2	5	3	2	8	6	26	1%
Transfer To Psych. In Acute Facility	3	4	3	7	2	3	22	0.5%
Transfer To Psychiatric Facility	6	2	3		3		14	0.3%
Transfer To Substance Abuse Facility			1		1		2	0.04%
Total	715	695	741	757	831	831	4570	100%

Most TBI Inpatient discharges release the patient to go home and practice self-care (53%), or are released to go home with home health services (12%). The remaining patients need further care in a professional rehabilitation setting (approximately 36%). Although most are discharged to home and then self-care, this does not mean that there was a full recovery. In fact, most of these people have ongoing disabilities that take months and years to fully heal, if at all.

Emergency Department Discharges for TBI Occurrences by Disposition

Table 14: Emergency Department Discharges for TBI Occurrences by Disposition and Year, 2000-2005

Disposition	2000	2001	2002	2003	2004	2005	Total	%
Home THEN Self Care	5377	5967	5923	6359	6755	7626	38007	95%
Other Short Term Hospital	167	162	207	271	314	339	1460	4%
Against Medical Advice	37	26	30	30	48	57	228	1%
Skilled Nursing Facility	19	16	14	15	35	45	144	0.4%
Intermediate Care Facility	8	18	14	17	12	25	94	0.2%
Structured/Assisted Living	10	12	8	16	13	33	92	0.2%
Transfer To Psychiatric Facility	1	4	4	4	5	3	21	0.1%
Home Health Service	2		4	3	4	2	15	0.04%
Transfer To Psych. In Acute Facility	2	3	2	2	1	2	12	0.03%
Transfer To Substance Abuse Facility	2	1		1	2	6	12	0.03%
Other or Unknown	1	3			1	1	6	0.01%
Transfer To Rehabilitation Facility			1	1	1	3	6	0.01%
Transfer To Rehab. In Acute Facility						2	2	0.005%
Total	5626	6212	6207	6719	7191	8144	40099	100%

Most TBI ED discharges release the patient to go home and practice self-care (95%). Four percent required a short-term hospital stay, and the remaining (approximately 1%) were discharged to various professional rehabilitation facilities.

Inpatient Discharges for TBI by New Hampshire County

Table 15a: Occurrence of Inpatient Discharge for TBI by NH County and Year, 2000-2005

County	2000	2001	2002	2003	2004	2005	Total
BELKNAP	37	34	25	34	46	34	210
CARROLL	28	35	27	31	33	48	202
CHESHIRE	37	44	36	39	37	54	247
COOS	29	28	33	34	38	37	199
GRAFTON	48	37	51	52	53	53	294
HILLSBOROUGH	211	229	231	233	238	258	1400
MERRIMACK	84	78	85	71	101	98	517
ROCKINGHAM	153	136	142	166	185	154	936
STRAFFORD	59	49	77	67	68	64	384
SULLIVAN	29	25	34	30	32	31	181
Total	715	695	741	757	831	831	4570

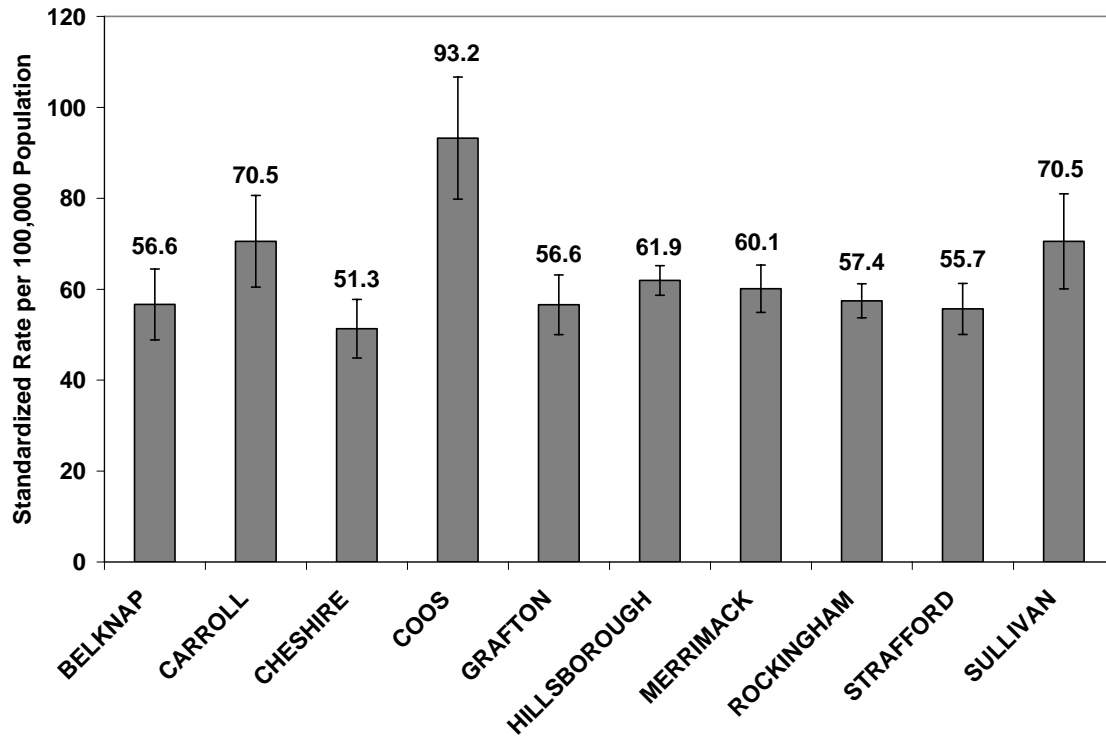
Table 15b: Standardized Rate of Inpatient Discharge for TBI by NH County, 2000-2005

County	Count	Standardized Rate	Lower 95% CI*	Upper 95% CI*
BELKNAP	210	56.6	48.9	64.4
CARROLL	202	70.5	60.4	80.6
CHESHIRE	247	51.3	44.8	57.8
COOS	199	93.2	79.8	106.6
GRAFTON	294	56.6	50.0	63.2
HILLSBOROUGH	1,400	61.9	58.7	65.2
MERRIMACK	517	60.1	54.9	65.3
ROCKINGHAM	936	57.4	53.7	61.2
STRAFFORD	384	55.7	50.1	61.3
SULLIVAN	181	70.5	60.1	81.0

*CI = Confidence Interval

The chart above shows that there is no significant difference in the rate of TBI Inpatient discharges for all counties between 2000 and 2005, except for Coos County. Coos County has a significantly higher rate than every other county (99.2 per 100,000, CI 79.8-106.6), with the exception of Carroll and Sullivan Counties.

Figure 13: Standardized Rate of Inpatient Discharge for TBI by NH County, 2000-2005



Emergency Department Discharges for TBI by New Hampshire County

Table 16a: Occurrence of Emergency Department Discharges for TBI by NH County and Year, 2000-2005

County	2000	2001	2002	2003	2004	2005	Total
BELKNAP	256	326	355	425	447	525	2334
CARROLL	265	260	242	329	346	324	1766
CHESHIRE	218	273	269	310	319	358	1747
COOS	211	237	224	252	226	289	1439
GRAFTON	342	391	370	358	402	421	2284
HILLSBOROUGH	1691	2088	2064	2119	2370	2771	13103
MERRIMACK	691	719	767	828	852	964	4821
ROCKINGHAM	1268	1236	1258	1456	1551	1703	8472
STRAFFORD	446	478	470	473	480	634	2981
SULLIVAN	255	221	217	200	232	212	1337
Total	5643	6229	6236	6750	7225	8201	40284

Table 16b: Standardized Rate of Emergency Department Discharges for TBI by NH County, 2000-2005

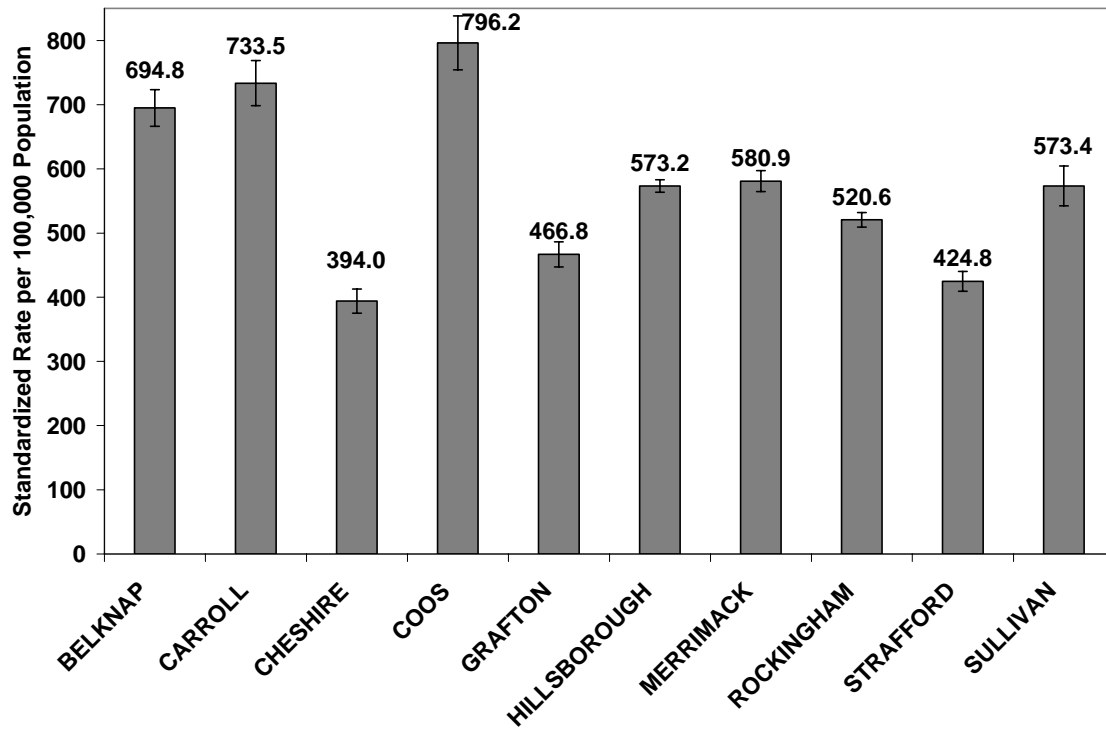
County	Count	Standardized Rate	Lower 95% CI*	Upper 95% CI*
BELKNAP	2,334	694.8	666.3	723.4
CARROLL	1,766	733.5	698.4	768.6
CHESHIRE	1,747	394.0	375.2	412.8
COOS	1,439	796.2	754.1	838.3
GRAFTON	2,284	466.8	447.3	486.4
HILLSBOROUGH	13,103	573.2	563.4	583.1
MERRIMACK	4,821	580.9	564.4	597.4
ROCKINGHAM	8,472	520.6	509.5	531.8
STRAFFORD	2,981	424.8	409.5	440.2
SULLIVAN	1,337	573.4	542.3	604.5

**CI = Confidence Interval*

The chart below shows that there are significant differences in the rate of TBI emergency department discharges for most counties between 2000 and 2005. Belknap, Carroll and

Coos counties have significantly higher rates than the other counties. Cheshire, Grafton, and Strafford have significantly lower rates than the other counties.

Figure 14: Standardized Rate of Emergency Department Discharges for TBI by NH County, 2000-2005



Inpatient Discharges for TBI by Month

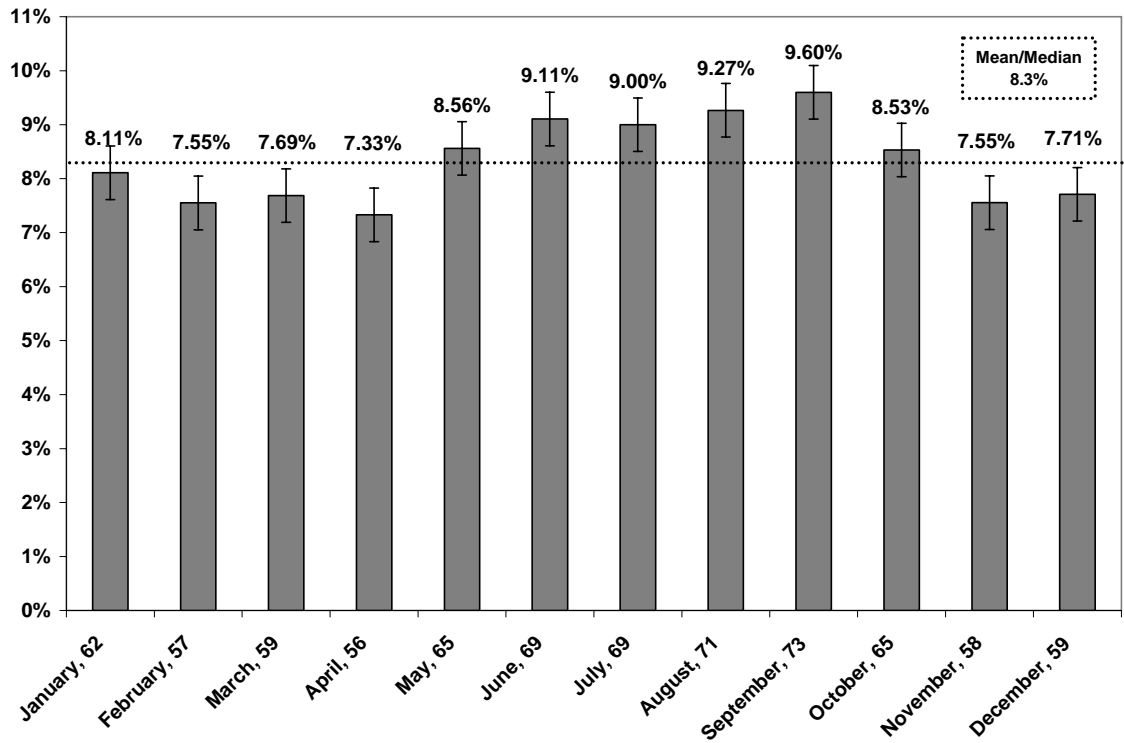
Table 17a: Occurrence of Inpatient Discharges for TBI by Month and Year, 2000-2005

Month	2000	2001	2002	2003	2004	2005	Total	Average Per Year
January	57	64	45	52	81	73	372	62
February	66	55	60	48	46	68	343	57
March	40	50	64	74	66	58	352	59
April	54	54	62	47	54	63	334	56
May	71	48	50	80	70	73	392	65
June	74	53	83	67	80	58	415	69
July	51	59	69	76	77	81	413	69
August	67	65	64	58	84	87	425	71
September	77	74	63	72	88	63	437	73
October	61	67	77	61	61	60	387	65
November	47	50	46	58	69	78	348	58
December	50	56	58	64	55	69	352	59
Total	715	695	741	757	831	831	4570	762

Table 17b: Percent of Total Inpatient Discharges for TBI by Month, 2000-2005

Month	2000	2001	2002	2003	2004	2005	Average Per Year
January	8%	9%	6%	7%	10%	9%	8.1%
February	9%	8%	8%	6%	6%	8%	7.6%
March	6%	7%	9%	10%	8%	7%	7.7%
April	8%	8%	8%	6%	6%	8%	7.3%
May	10%	7%	7%	11%	8%	9%	8.6%
June	10%	8%	11%	9%	10%	7%	9.1%
July	7%	8%	9%	10%	9%	10%	9.0%
August	9%	9%	9%	8%	10%	10%	9.3%
September	11%	11%	9%	10%	11%	8%	9.6%
October	9%	10%	10%	8%	7%	7%	8.5%
November	7%	7%	6%	8%	8%	9%	7.6%
December	7%	8%	8%	8%	7%	8%	7.7%

Figure 15: Percent of Six-Year Average Inpatient Discharges for TBI by Month, 2000-2005



The percent of total TBI Inpatient discharges is higher than average June through September. February through April, November, and December have lower than average TBI Inpatient discharges.

Emergency Department Discharges for TBI by Month

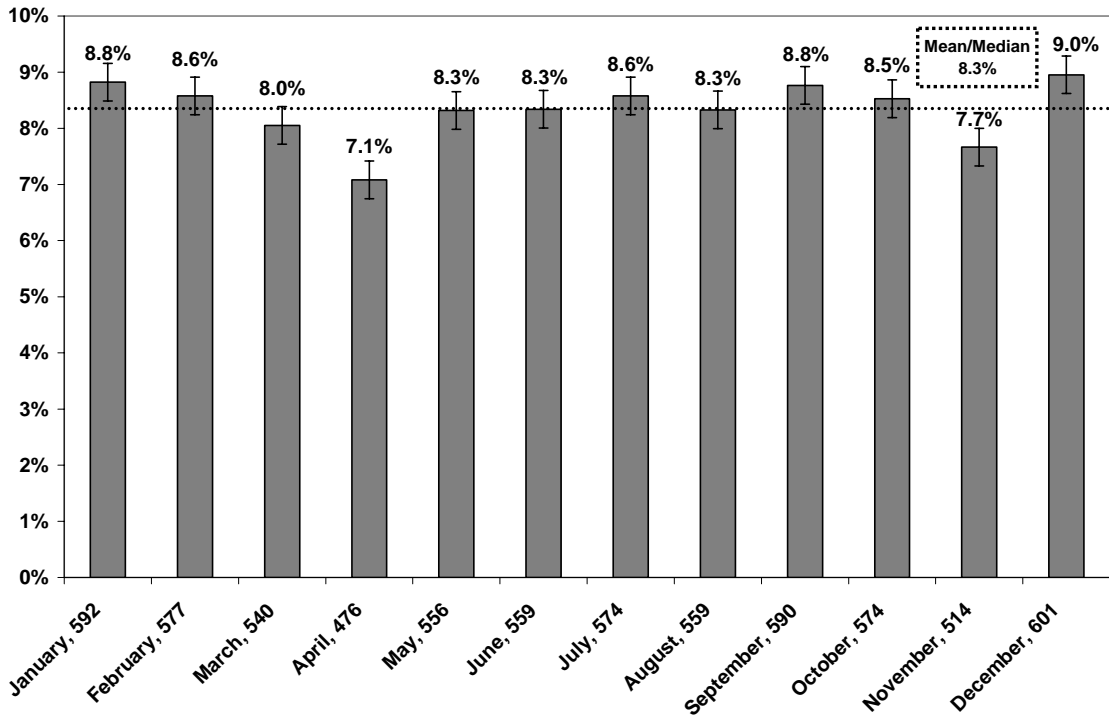
Table 18a: Occurrence of Emergency Department Discharges for TBI by Month and Year, 2000-2005

Month	2000	2001	2002	2003	2004	2005	Total	Average Per Year
January	451	581	621	572	600	728	3553	592
February	486	568	503	532	635	737	3461	577
March	465	507	484	552	567	667	3242	540
April	379	441	478	464	513	578	2853	476
May	500	540	521	510	619	648	3338	556
June	471	518	548	557	600	659	3353	559
July	482	583	529	608	564	678	3444	574
August	480	492	527	574	609	671	3353	559
September	484	517	543	618	634	743	3539	590
October	455	554	471	595	675	696	3446	574
November	447	438	464	530	560	656	3095	516
December	543	490	547	638	649	740	3607	601
Total	5643	6229	6236	6750	7225	8201	40284	6714

Table 18b: Percent of Total Emergency Department Discharges for TBI by Month, 2000-2005

Month	2000	2001	2002	2003	2004	2005	Average Per Year
January	8%	9%	10%	8%	8%	9%	8.8%
February	9%	9%	8%	8%	9%	9%	8.6%
March	8%	8%	8%	8%	8%	8%	8.0%
April	7%	7%	8%	7%	7%	7%	7.1%
May	9%	9%	8%	8%	9%	8%	8.3%
June	8%	8%	9%	8%	8%	8%	8.3%
July	9%	9%	8%	9%	8%	8%	8.6%
August	9%	8%	8%	9%	8%	8%	8.3%
September	9%	8%	9%	9%	9%	9%	8.8%
October	8%	9%	8%	9%	9%	8%	8.5%
November	8%	7%	7%	8%	8%	8%	7.7%
December	10%	8%	9%	9%	9%	9%	9.0%

Figure 16: Percent of Six-Year Average Emergency Department Discharges for TBI by Month, 2000-2005



There is little variance from the average percent of TBI ED discharges from month to month, with the exceptions of April and November, which are below average, and January, September, and December, which are above average.

References

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4. Finkelstein E, Corso P, Miller T and associates. *The Incidence and Economic Burden of Injuries in the United States*. New York (NY): Oxford University Press; 2006.
5. Centers for Disease Control and Prevention (CDC), National Center for Injury Prevention and Control. *Traumatic brain injury in the United States—A report to Congress*. Atlanta (GA): Centers for Disease Control and Prevention; 1999.
6. Correspondence from Bruce Lawrence, Pacific Institute for Research and Evaluation, Children’s Safety Network, July 2008.

Caveats for costing data

- Case selection for fatalities was based on state of residence, while that for hospital admissions was based on state of hospitalization, since the data source, HCUP-NIS, does not give state of residence.
- The HCUP-NIS is stratified to be representative at the national level, not the state level.
- Entity axis field from part one, not part of the death certificate field were selected.
- For hospitalizations, the first five head-injury diagnoses fields were selected.