

TRAUMATIC BRAIN INJURIES IN PENNSYLVANIA

Hospital Discharges 1995-1999

Traumatic Brain Injuries in Pennsylvania, 1995-1999



An Injury Profile Monograph

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List of Abbreviations and Special Symbols

TBI	Traumatic Brain Injury/Injuries
E-code	External cause of injury code
HDD	Hospital Discharge Data
ICD-9-CM	International Classification of Diseases, Ninth Edition, with Clinical Modification
PHC4	Pennsylvania Health Care Cost Containment Council
NEC	Not elsewhere Classifiable
.	Rate not computed, < 5 cases. Statistic not computed, 0 cases.
MVT	Motor Vehicle Traffic

Executive Summary

This monograph reports on the epidemiology and hospital charges for traumatic brain injuries to Pennsylvania residents discharged from Pennsylvania hospitals during 1995-1999. The data are derived from acute care institutions reporting hospital discharge data to the Pennsylvania Health Care Cost Containment Council (PHC4). Data on patients who died before being admitted to a hospital, patients treated and released from emergency departments, and patients treated at rehabilitation hospitals were excluded.

Between 1995-1999, there were 74,578 hospital discharges involving head injuries, yielding a rate of 124.3 per 100,000 persons. Private and commercial insurance sources were responsible for the highest percentage of charges (63%, \$583.5 million) while government sources were responsible for over 16 percent (146.4 million).

Among TBI discharges involving Pennsylvania residents, 62.2 percent were males. There were 5.3% reported fatalities during the hospitalization stay. TBI discharges were highest among persons 15-19 years of age, accounting for 10.4 percent of all cases. TBI discharges among persons aged 39 years and younger accounted for just over half of all cases (50.9%). Rates peaked in two age groups: 15-19 years of age (184.7 per 100,000) and 85 years and older (424.0 per 100,000). The rate for males was 160.5 per 100,000 compared to 90.6 for females. Black males were found to have rates higher than those found in white males (225.3 vs. 137.5). The maximum length of stay was 314 days and the median was 3 days. The median charge per case for injuries involving the head was \$10,096 and the maximum was \$1.67 million.

The most common injury mechanisms for TBI were transport-related incidents (44.5%), falls (34.8%), and being struck by or thrown against something (8.3%). Transport-related mechanisms were the most common cause among persons 5-59 years, while falls were the most common cause for under 5 and 60 years of age and older. The percent of injury involving the head that was due to firearms was over 5 times greater in black males than in white males (5.6% vs. 1.0%). Nearly eight percent of all TBI were coded as intentional and males were almost 3 times as likely to suffer a TBI due to an assault as females. Blacks were more than six times as likely as whites to sustain an assault-related TBI.

Fact Sheet

Traumatic Brain Injuries in Pennsylvania, 1995-1999

- A total of 74,578 injuries involving the head (124.3 per 100,000 persons) were reported.
- Young people ages 15–19 years old comprised over ten percent of all TBI, the largest of any five-year age group.
- From 1995-1999 the total hospitalization period for all TBI discharges was 468,329 hospital days. The median hospital length of stay was 3 days per TBI discharge.
- Across all age groups males had a higher discharge rates for TBI than females (160.5 vs. 90.6).
- Black males had higher discharge rates for TBI than white males (225.3 vs. 137.5).
- Most TBI were the result of a transport-related incident (44.5%).
- For persons involved in a transport-related incident, the most common cause of the incident was being an occupant in a motor vehicle (78.7%).
- For persons 60 years and older, falls were the most common cause of TBI (71.3%).
- The percent of TBI involving firearms was over 5 times higher in black males than in white males (5.6% vs. 1.0%).
- Over five percent of TBI discharges were fatal (5.3%).
- \$1.85 billion was charged for TBI in Pennsylvania acute care hospitals from 1995-1999.
- Of the total charges, private insurance was responsible for covering the highest percentage (63%, \$583.5 million) while government sources were responsible for over 16 percent (\$146.4 million).
- For TBI, males were almost 3 times as likely to have suffered an assault as females (10.6% vs. 3.6%).
- The percent of assault related TBI was nearly 6 times higher among blacks than whites (27.2% vs. 4.7%).

Introduction

The Traumatic Brain Injury Problem

Traumatic brain injuries (TBI) pose a significant public health problem throughout the United States. It is estimated that the annual mortality rate for TBI ranges from 22 to 30 per 100,000 persons in the United States, accounting for between 56,000 and 75,000 deaths each year.³ In 1994 there were 1,980 TBI associated deaths in Pennsylvania (16.6 per 100,000 persons): fortunately, this rate has been decreasing.¹ In 1985 the mortality rate was 19.2 per 100,000 persons.* In 1992, the number of deaths in the United States due to injury was only 1,000 less than the total number of deaths attributed to cerebrovascular disease.² More of these injury deaths have been attributed to TBI than any other specific body region.³

Fatalities, however, represent the smallest proportion of these injury events. It is estimated that two out of every 1,000 persons suffer from a TBI each year.³ Applying this rate to the United States population of 270 million results in an estimated 540,000 persons who are admitted to a hospital or who die before reaching a hospital.

The economic burden of this morbidity is substantial. A survivor of a severe brain injury may need several years of intense treatment and rehabilitation services with lifetime charges estimated to exceed \$4 million.⁴ Because many of these injuries occur in young adults who may live an additional 30 to 40 years, the overall economic impact of brain injury in the United States is enormous - estimated to be between \$12.5 billion⁵ and \$37 billion per year.⁶

Hospitalized Traumatic Brain Injuries in Pennsylvania

This monograph describes the epidemiology and hospital discharges of 74,578 injuries involving the head and/or brain of persons who were treated and discharged from Pennsylvania hospitals in 1995-1999. The PHC4 compiles data on inpatient discharges from all non-federal hospitals in Pennsylvania. This report covers all injuries involving the head and/or brain, both intentional and unintentional, derived from analysis of the data from all acute care hospitals in the data set. Cases discharged from rehabilitation facilities were not included in most analyses in order to decrease the chance of double-counting cases and to emphasize the incidence of these injuries. It was assumed that cases admitted to a rehabilitation facility were first admitted to an acute care facility and would be counted there. These data contain a rich array of information about hospitalized cases including demographics, diagnoses, injury causes, disposition, total charges and payer source, among other variables. However, this data set does not contain information on safety-related behaviors, nor does it include people who died before being admitted to a hospital. *Disclaimer:* The exact percentage of TBI mortality and morbidity is rather unknown. It is, however, estimated based on epidemiological studies using different statistical methodologies and approaches. Because methodologies differ in defining and identifying significant cases of TBI mortality and morbidity, statistical data on this issue may vary.

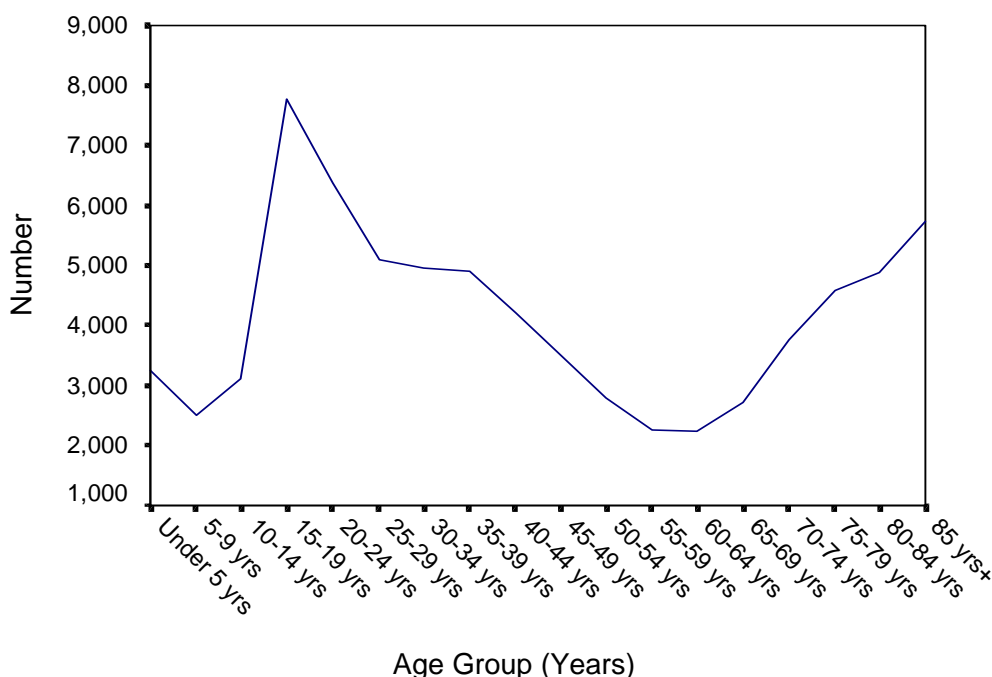
* Rate age adjusted for 1980 population. Definition includes ICD codes 800.0-801.9, 803.0-804.9, 850.0-854.1, 873.0-873.9, and 905.0-907.9.

Demographics

Between 1995-1999, there were a total of 74,578 hospital discharges in Pennsylvania involving head injury (124.3 per 100,000) Of the TBI cases, 62.2 percent were male. The distribution of discharges by age showed a tri-modal distribution, with the 15-19 year old age group reporting the most cases. Persons less than 5 years old and persons greater than 85 years old also displayed increased numbers of TBI.

Figure 1
TBI by Age Group

Acute Hospital Discharges, Pennsylvania, 1995-1999

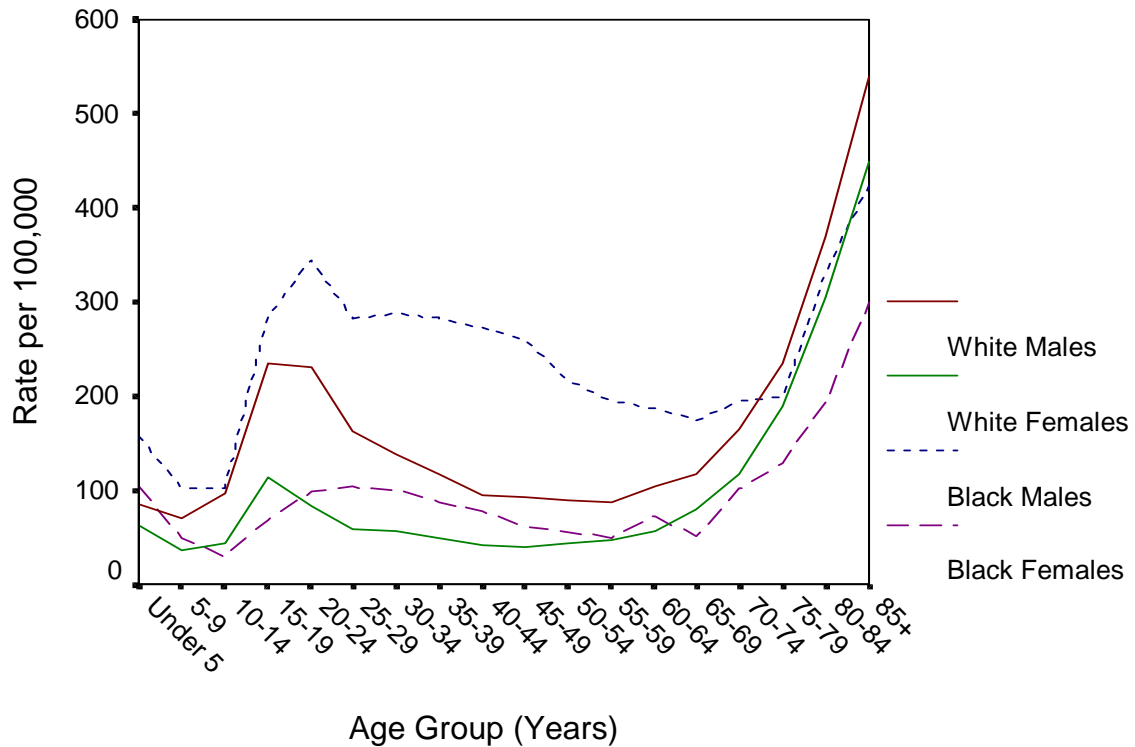


Source: PHC4

TBI rates peaked in persons 85 years and older for black females, white males, and white females, but peaked in persons 20-24 years for black males. Black males also demonstrated a peak in persons 15-19 years old compared to the other race/gender categories. There was a smaller peak in those 15-19 years old for whites. Because of the larger population size, however, people ages 15-19 years contributed significantly more overall cases. The 15-19 year old age group comprised nearly eleven percent of all TBI, the largest of any 5-year group. The male injury rate mirrored that of the overall rate, increasing from 100.8 cases per 100,000 in those under-5 years of age to the first peak of 256.9 per 100,000 cases in those 15-19 years old. It dropped again before rising to a peak of 439.4 cases per 100,000 for those 85 years and older. Across all age categories males had a higher rate than females.

Figure 2
Discharge Rates of TBI by Age Group and Gender
Blacks and Whites

Acute Hospital Discharges, Pennsylvania, 1995-1999

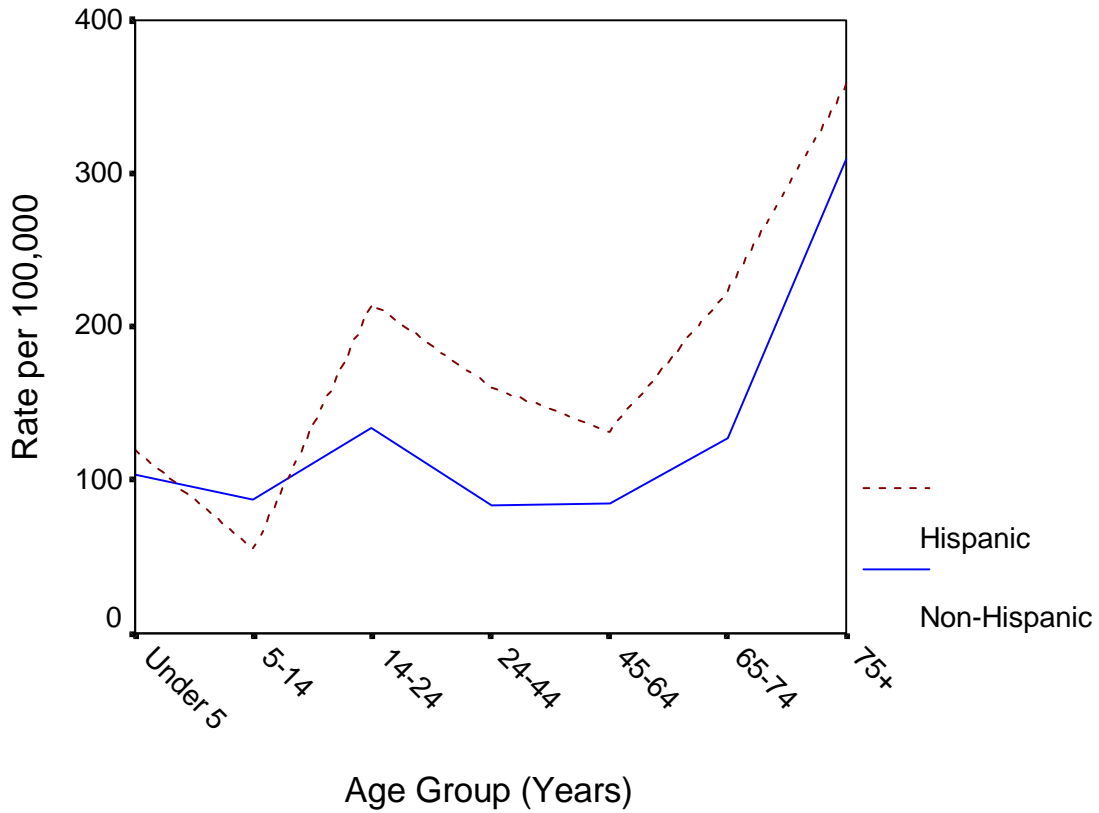


Source: PHC4

Blacks generally had higher TBI rates than whites. Black males had a 1.6 times higher rate of TBI than white males, with a rate of 225.3 cases per 100,000 for black males and a rate of 137.5 per 100,000 for white males. Overall, black and white female rates were similar. Black females had a rate of 80.8 cases per 100,000 while white females had a slightly higher rate of 84.0 cases per 100,000. The distribution of the age-specific rates showed a difference between whites and blacks. Whites had two distinct peaks, one in 15–19 year olds and one in those 85 years or older. For males, the rates in the 85-year group were greater than 1.5 times that of those 15–19 years old. For females, this difference was more than 3.5 times greater. In black males there were three peaks; in persons 15–19 years old, 20-24 years old, and those 85 years old and greater. As was seen in white females, elderly black females had much higher rates than younger black females. Rates for TBI by sex for total, black and white races are shown in the appendix.

Figure 3
Discharge Rates of TBI by Age Group and Ethnicity

Acute Hospital Discharges, Pennsylvania, 1995-1999



Source: PHC4

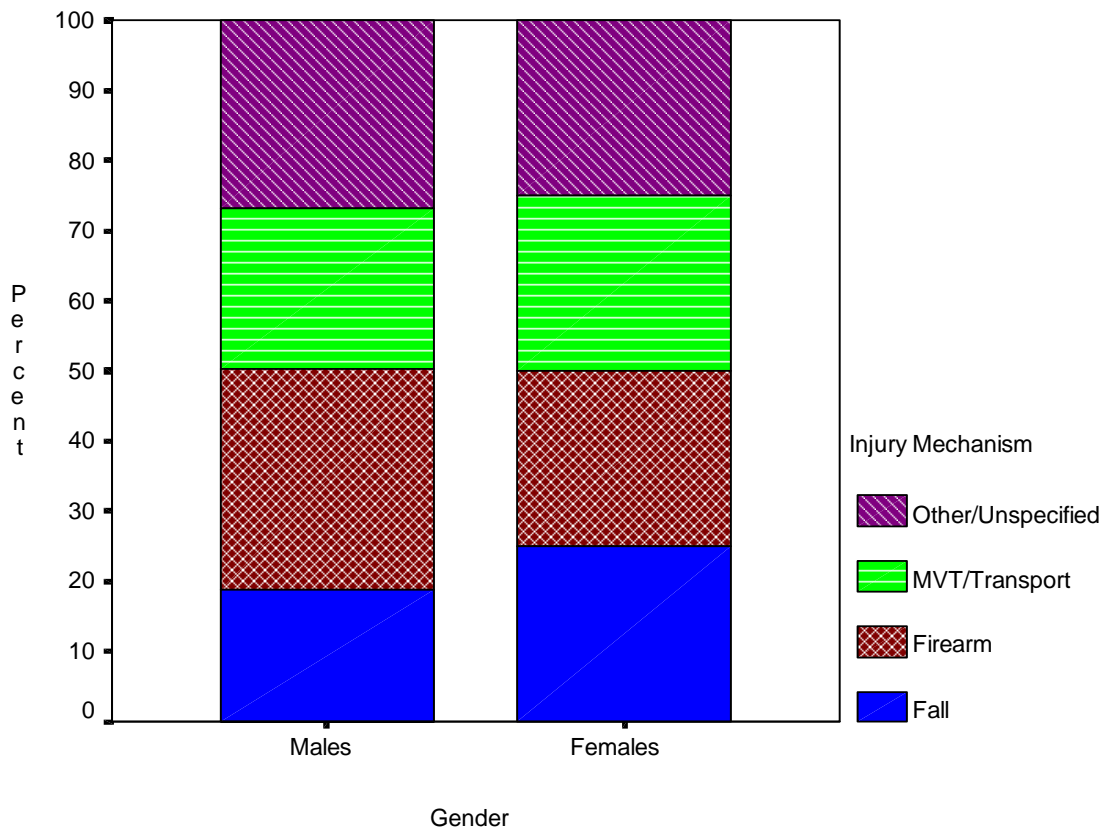
There were 1,922 (male=1,395, female=527) patients of Hispanic origin involving a TBI. The hospital discharge rates varied by age, with persons 75 years and older reporting the highest rates (358.1 per 100,000 persons). The rates for Hispanics generally fell between the rates of whites and blacks.

Mechanisms

For TBI, the three most common mechanisms were transport-related incidents, falls, and being struck by or thrown against something. More than half (52.4%) of all TBI were the result of a transport-related incident. Of those hospital discharges that were transport-related, 63.5 percent were occupants in a motor vehicle. The second most common mechanism was falls, comprising 34.8 percent. TBI mechanisms vary dramatically by age. For those under 16 years of age, transport-related incidents were the most common mechanism of injury comprising 44.4% and falls were the second most common mechanism comprising 34.9%. Being struck by or against something comprised 9.4%. For persons 16-64 years of age, a different pattern showing a much wider gap between injuries caused by transport-related incidents and falls was observed. The percentage of injuries due to transport vehicles increased to 60.0% and the percentage of injuries due to falls decreased to 17.6%. A small increase to 11.2% was observed in the proportion of injuries due to being struck or thrown against something. In persons 65 years and older another pattern emerged, with falls accounting for the most common mechanism, increasing to 69.5%. Transport-related injuries decreased to 19.4% while injuries due to being struck by or against something decreased to 1.9%.

Figure 4
Percent of Injuries Due to Specific Mechanisms for TBI

Acute Hospital Discharges, Pennsylvania, 1995-1999



Source: PHC4

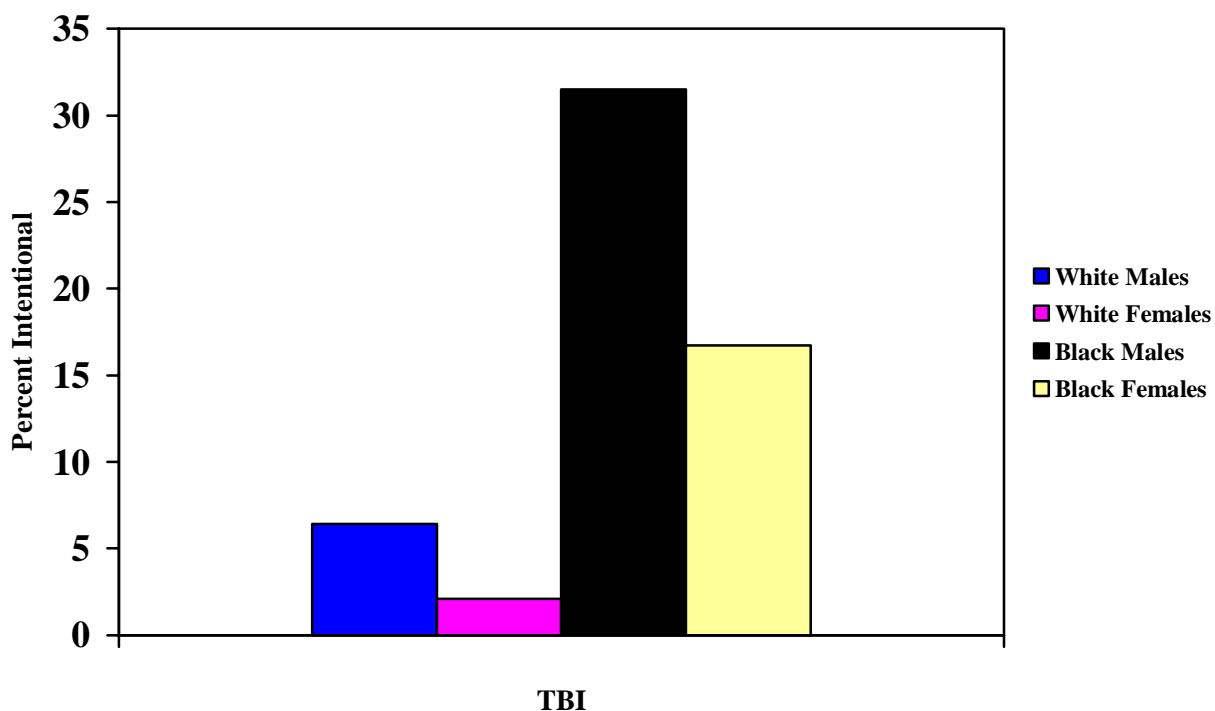
The mechanisms for TBI also varied dramatically by race and sex. The percent of TBI from being struck by or against something was almost two-and-a-half times higher in black males than in white males (23.0% vs. 8.7%). A similar pattern was seen when comparing white and black females. The proportion of cases related to transport-related incidents and falls was lower in black males.

Intent

Over 73% of TBI injury discharges were unintentional (73.8%). Males were 3 times as likely to have suffered an assault as females (10.2% vs. 3.4%). The difference was even more dramatic between whites and blacks. Blacks were nearly 6 times more likely to have sustained an assault (26.2%) versus whites (4.5%). The intent of TBI showed little relationship with age. Nearly (7.9%) eight percent of hospital discharges involving head injured persons who were less than five years of age were reported as assaults. This percent dropped to 0.3% in those 5-9 years of age. It then steadily rose to 16.8% in those 35-39 years old, then declined. Refer to the Appendix for additional TBI hospital discharge data on Intent.

Figure 5
Percent Intentional TBI by Race and Gender

Acute Hospital Discharges, Pennsylvania, 1995-1999



Source: PHC4

Hospital Admission Source and Disposition

The majority of TBI cases were admitted through the emergency room (82.5%). Other admission sources comprised the remainder of all admissions, with the second leading single source (physician referral) contributing 7.3%. Over 67% percent of TBI discharges were routinely discharged to home or self-care. Five percent of the TBI discharges were fatal (5.3%).

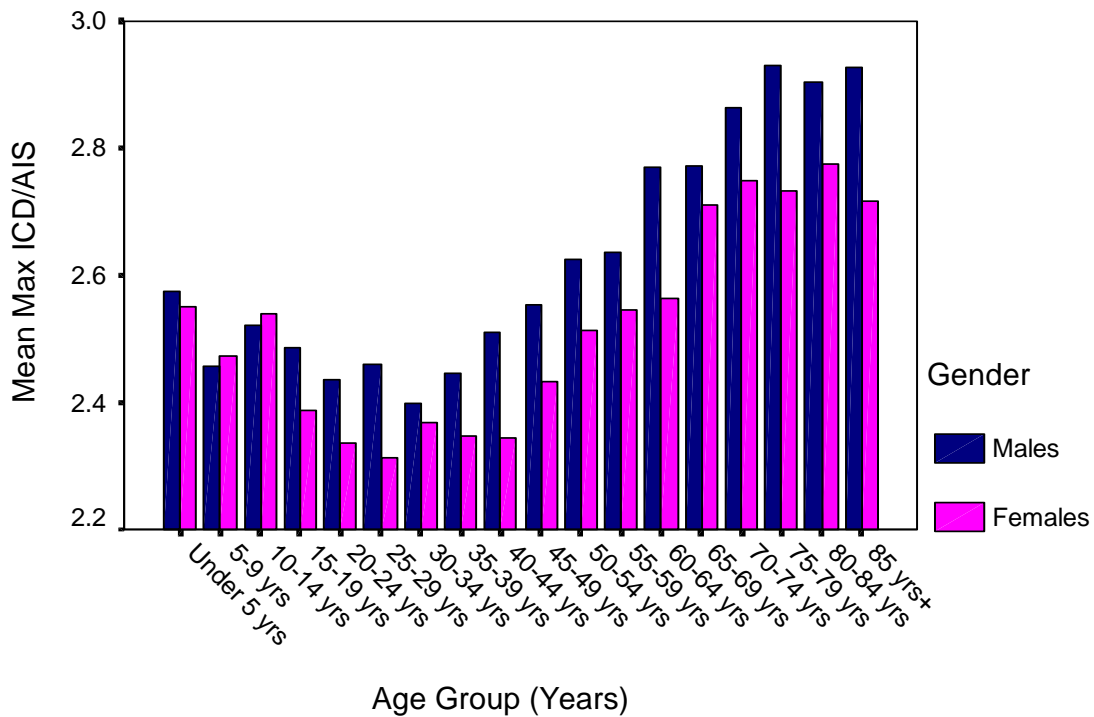
Severity

The maximum Abbreviated Injury Scale (MAX AIS) was used to describe severity of injury.⁷ MAX AIS is a numerical scale ranging from one to six, with one representing a minor injury and six representing a major, virtually unsurvivable injury. The MAX AIS was computed using the ICDMAP-90 computer program and is referred to as the MAX ICD/AIS. MAX ICD/AIS was categorized as "minor" (MAX ICD/AIS=1-2), "moderate" (MAX ICD/AIS=3), "serious" (MAX ICD/AIS=4), and "severe" (MAX ICD/AIS=5-6). Details on this variable can be found in the Technical Notes and Methods section.

For TBI, the mean MAX ICD/AIS was 2.5. The mean MAX ICD/AIS score showed a bimodal distribution. A peak of the MAX ICD/AIS was seen in those less than 5 years of age and in the elderly. Females showed a slightly lower mean MAX ICD/AIS across most age groups.

Figure 6
**Mean MAX ICD/AIS Score for TBI by Age,
 Males and Females**

Acute Hospital Discharges, Pennsylvania, 1995-1999

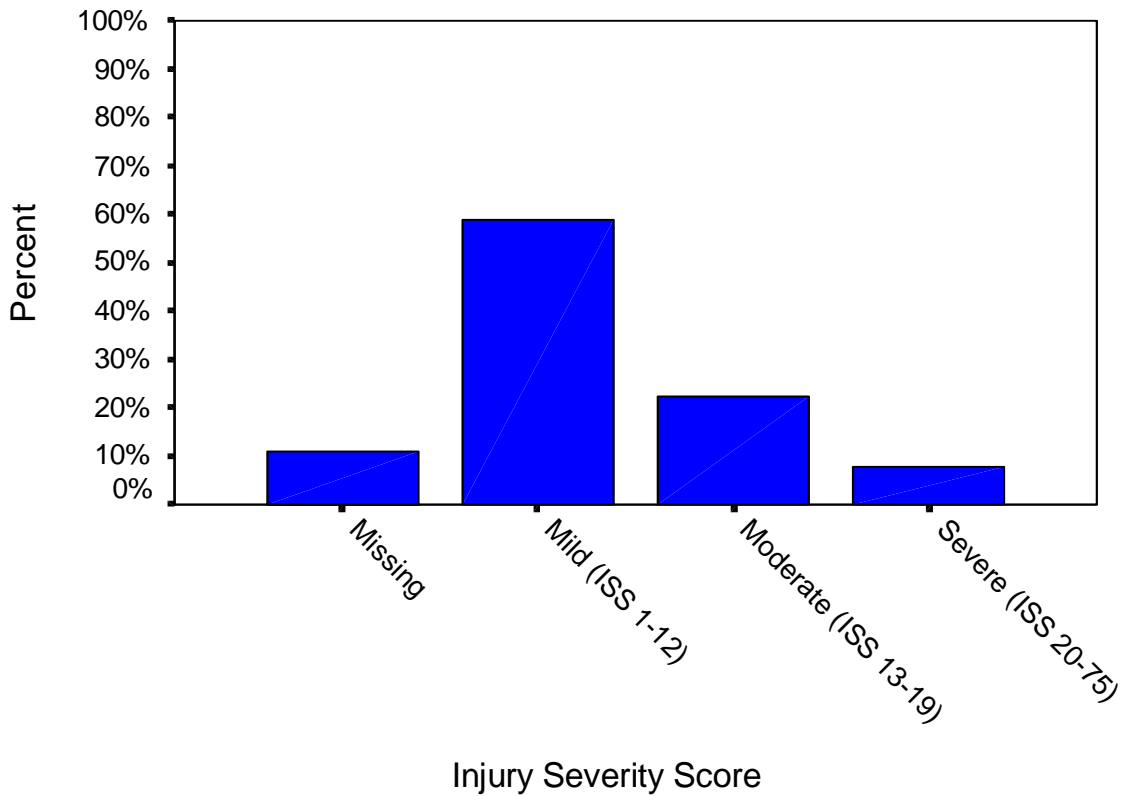


Source: PHC4

TBI injuries were mostly coded as minor (58.9%), 22.3% were coded as serious and 7.8% were coded as severe. There was no significant difference when comparing mean MAX ICD/AIS between males and females. In general, whites had slightly more severe injuries than nonwhites (2.6 versus 2.4 mean MAX ICD/AIS). White males had a mean MAX ICD/AIS of 2.5 and black males had a mean MAX ICD/AIS of 2.3. White females had a mean MAX ICD/AIS of 2.5 and black females had a mean MAX ICD/AIS of 2.2.

Figure 7 Severity of TBI

Acute Hospital Discharges, Pennsylvania, 1995-1999



Source: PHC4

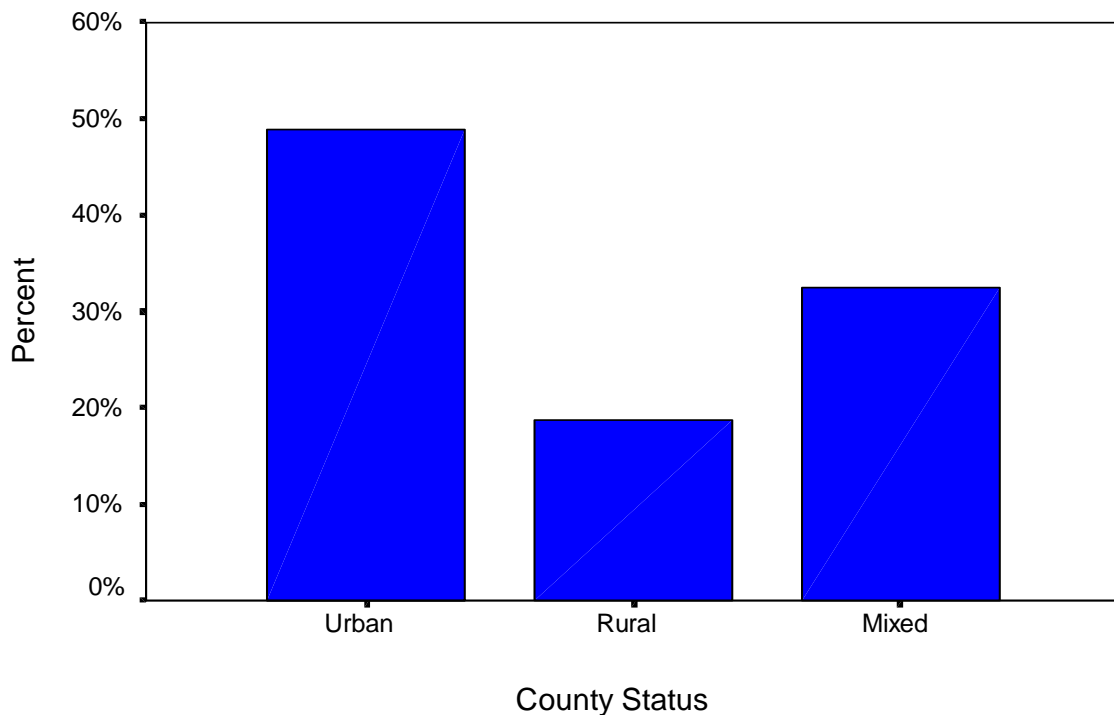
Time and Place

The time of year that people were more likely to be discharged from the hospital for TBI did not vary substantially by month or quarter.

Philadelphia and Allegheny counties ranked highest for TBI discharges. Philadelphia residents comprised 16.3% and Allegheny residents comprised 11.7% of TBI. The rates by county status of injury per 100,000 persons were as follows; urban = 128.2, mixed = 125.6, rural = 132.6. The higher rates in rural counties were at least partly due to smaller populations. The percent of transport-related incidents decreased as counties became less urban. Since these incidents are the largest cause of TBI, it is no surprise that percentages are higher in urban areas. While TBI transport-related incidents decreased in the more rural counties, smaller populations contributed to the increase in the rates for the rural counties. A detailed county profile is presented as supplementary to this report.

Figure 8
Percent of TBI Caused by Transport-Related Incident by County of Residence Classification

Acute Hospital Discharges, Pennsylvania, 1995-1999



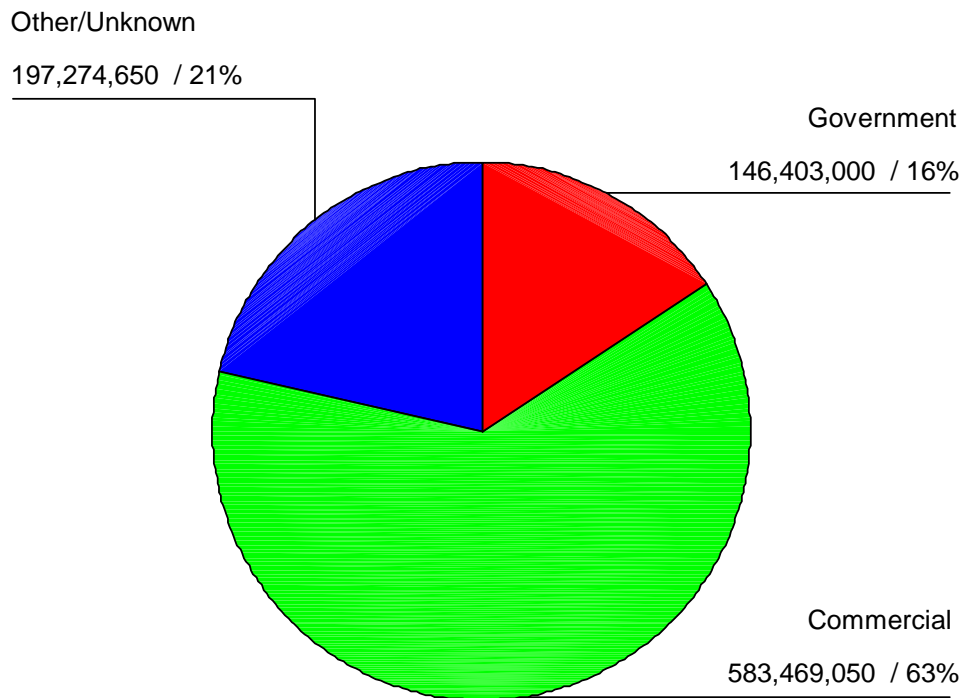
Source: PHC4

Hospital Charges

TBI led to \$1.85 billion in charges. The median charge per case was \$10,008. The maximum charge was \$1.67 million. Of the total charges, commercial and private insurance was responsible for the highest percentage (63.0%) while government sources were responsible for 16% (\$146.4 million) of the charges. The highest median charges by mechanism were for suffocations (\$27,801), firearms (\$27,116) and fire/burns (\$26,161).

Figure 9
Total Charges in Dollars and Percent by Payer Source for TBI

Acute Hospital Discharges, Pennsylvania, 1995-1999

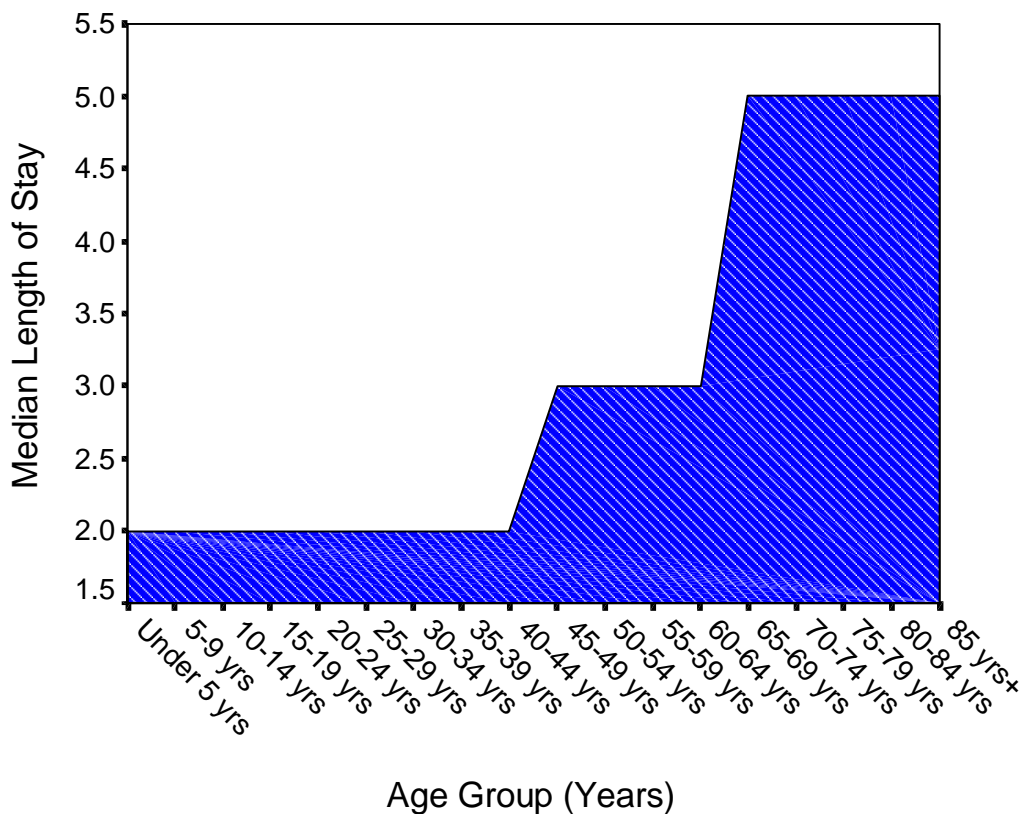


Source: PHC4

Length of Stay

For TBI, the median length of stay was three days (mean=6.3 days) with a maximum of 314 days, and was fairly similar for both males and females (two days vs. three days). In general, the median length of stay for TBI increased with age. Among persons less than five years old the median length of stay was one day, this continued to increase with age until it reached a peak of five days in persons greater than 65 years of age. The median length of stay varied depending on the mechanism of the injury. For TBI, suffocation led to the longest median length of stay, 8.0 days.

Figure 10
Median Length of Stay for TBI by Age
Acute Hospital Discharges, Pennsylvania, 1995-1999



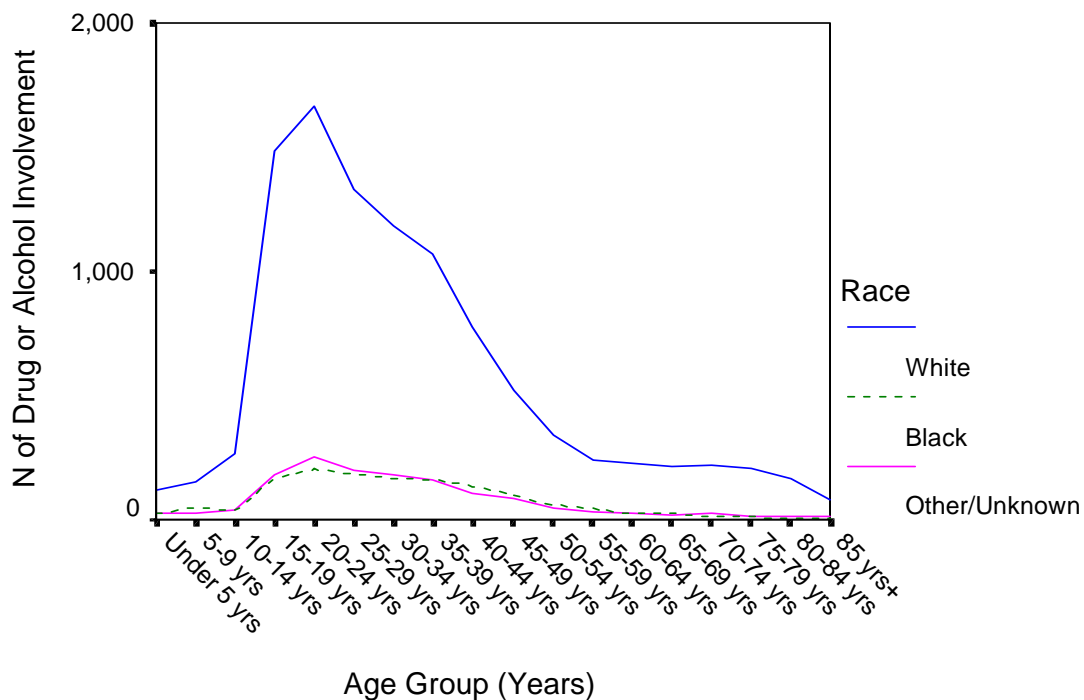
Source: PHC4

Substance Abuse-Related

Drugs were found to be involved in 13.4% and alcohol was found to be involved in 4.7% of the TBI. If the patient had *either* a drug or alcohol diagnosis, the case was defined as substance abuse-related. Substance abuse-related cases were involved in 14,445 (19.4%) of all TBI (some cases were both drug *and* alcohol related). The leading injury mechanism among substance abuse-related TBI was transport-related incidents (42.4%). These cases were predominantly male (59.7%), white (68.5%), and in the 20-39 year old age groups (52.9%). Substance abuse-related TBI rates per 100,000 population were calculated for white males (31.9), white females (8.1), black males (81.1), black females (17.0), Asian males (9.5) and Asian females (1.1). The median length of stay was 2 days; 1 day less than persons without screening positive for drugs or alcohol. The median charge was \$11,504. The median injury severity (MAX ICD/AIS) was 6.0. Note that alcohol involvement was derived by identifying alcohol-related diagnosis codes, not alcohol blood levels. Because of the likelihood that many acute alcohol episodes were not documented these should be considered an underestimate of alcohol-related injuries.

Figure 11
**Substance Abuse Involvement in TBI
 by Age Group and Race**

Acute Hospital Discharges, Pennsylvania, 1995-1999



Source: PHC4

Appendix

Detailed Supplemental Tables for Traumatic Brain Injuries

Table 1
Hospital Discharges for TBI by Age Group and Gender, Number and Rate

Acute Pennsylvania Hospital Discharge Data – 1995-1999

	Gender					
	Male		Female		Total	
	Number	Rate**	Number	Rate**	Number	Rate**
Under 5	1,943	100.8	1,293	70.5	3,236	86.0
5-9	1,678	82.5	827	42.9	2,505	63.2
10-14	2,228	109.7	884	45.7	3,112	78.4
15-19	5,451	256.9	2,317	111.2	7,768	184.7
20-24	4,784	237.4	1,605	81.0	6,389	159.8
25-29	3,718	190.2	1,366	72.0	5,084	132.0
30-34	3,534	166.5	1,412	66.7	4,946	116.7
35-39	3,495	156.7	1,399	61.6	4,894	108.7
40-44	2,975	134.1	1,228	53.8	4,203	93.3
45-49	2,479	121.9	1,025	48.1	3,504	84.2
50-54	1,851	106.4	937	50.6	2,788	77.6
55-59	1,449	99.6	796	50.0	2,245	73.7
60-64	1,406	112.1	836	58.0	2,242	83.2
65-69	1,528	137.0	1,182	84.3	2,710	107.7
70-74	1,956	200.2	1,787	131.8	3,743	160.4
75-79	2,106	277.4	2,486	210.4	4,592	236.6
80-84	1,981	396.2	2,897	329.1	4,878	353.4
85+	1,844	439.4	3,882	417.1	5,726	424.0
All Ages	46,406	160.5	28,159	90.6	74,565	124.3

Source: PHC4.

* Includes late effects and cases outside ICD codes 800-995 with valid E codes.

** Per 100,000 population, 1998; totals exclude missing data.

. Rate not calculated for <5 observations.

Note: All tables exclude missing data. Rates are not calculated for cells with less than 5 observations.

Table 2
**Hospital Discharges for TBI by Age Group and Gender, Number
and Rate, Black Race**

Acute Pennsylvania Hospital Discharge Data – 1995-1999

	Gender					
	Male		Female		Total	
	Number	Rate**	Number	Rate**	Number	Rate**
Under 5	381	157.8	243	103.9	624	131.3
5-9	285	102.1	134	49.5	419	76.2
10-14	258	101.9	73	29.6	331	66.3
15-19	683	283.8	157	68.9	840	179.2
20-24	667	344.8	197	97.9	864	219.0
25-29	573	282.6	231	103.4	804	188.6
30-34	601	287.7	226	100.3	827	190.5
35-39	624	283.1	210	86.6	834	180.2
40-44	563	272.8	182	77.7	745	169.0
45-49	421	259.2	124	61.1	545	149.2
50-54	260	216.7	87	55.2	347	125.1
55-59	184	194.7	66	49.9	250	110.3
60-64	148	187.2	81	71.4	229	119.0
65-69	137	174.1	59	52.0	196	102.0
70-74	125	195.0	96	101.6	221	139.3
75-79	95	198.8	98	128.8	193	155.8
80-84	77	333.3	93	194.8	170	240.0
85+	78	424.4	140	298.8	218	334.2
All Ages	6,160	225.3	2,497	80.8	8,657	148.6

Source: PHC4.

* Includes late effects and cases outside ICD codes 800-995 with valid E codes.

** Per 100,000 population, 1998; totals exclude missing data.

. Rate not calculated for <5 observations.

Table 3
**Hospital Discharges for TBI by Age Group and Gender, Number
and Rate, White Race**

Acute Pennsylvania Hospital Discharge Data – 1995-1999

	Gender					
	Male		Female		Total	
	Number	Rate**	Number	Rate**	Number	Rate**
Under 5	1,260	85.7	872	62.8	2,132	74.6
5-9	1,175	70.4	574	36.3	1,749	53.8
10-14	1,692	97.3	704	42.6	2,396	70.7
15-19	4,047	233.8	1,880	113.1	5,927	174.7
20-24	3,369	231.7	1,199	83.6	4,568	158.1
25-29	2,586	162.4	960	58.9	3,546	110.0
30-34	2,401	137.8	1,016	56.7	3,417	96.7
35-39	2,410	116.4	1,006	48.4	3,416	82.3
40-44	2,014	94.7	902	41.8	2,916	68.1
45-49	1,702	92.9	772	40.4	2,474	66.1
50-54	1,357	88.5	712	43.6	2,069	65.3
55-59	1,069	87.5	641	48.0	1,710	66.8
60-64	1,070	103.2	653	56.1	1,723	78.3
65-69	1,202	118.0	991	80.0	2,193	97.2
70-74	1,614	165.4	1,502	117.5	3,116	138.2
75-79	1,790	233.9	2,137	188.7	3,927	206.9
80-84	1,704	368.2	2,503	305.0	4,207	327.8
85+	1,546	540.1	3,343	448.2	4,889	473.7
All Ages	34,008	137.5	22,367	84.0	56,375	109.8

Source: PHC4.

* Includes late effects and cases outside ICD codes 800-995 with valid E codes.

** Per 100,000 population, 1998; totals exclude missing data.

. Rate not calculated for <5 observations.

Table 4
Mechanism of TBI

Acute Pennsylvania Hospital Discharge Data – 1995-1999

		Frequency	Percent
Valid	Cut/pierce	191	.3
	Drowning/submersion	22	.0
	Fall	25,988	34.8
	Fire/flame	32	.0
	Hot object/substance	14	.0
	Firearm	937	1.3
	Machinery	243	.3
	MVT Occupant	24,870	33.3
	MVT Motorcyclist	1,630	2.2
	MVT Pedal cyclist	872	1.2
	MVT Pedestrian	3,338	4.5
	MVT Unspecified	597	.8
	MVT Other	305	.4
	Pedal cyclist, other	1,330	1.8
	Pedestrian, other	175	.2
	Transport, other	1,559	2.1
	Bites/stings	22	.0
	Other natural/environ	174	.2
	Overexertion	15	.0
	Poisoning	132	.2
	Struck by, against	6,189	8.3
	Suffocation	35	.0
	Other specified & classifiable	729	1.0
	Other specified, NEC	385	.5
	Unspecified	1,753	2.4
	Total	71,537	95.9
Missing	3,041	4.1	
Total	74,578	100.0	

Source: PHC4

Table 5
Mechanism of TBI by Age Group

Acute Pennsylvania Hospital Discharge Data – 1995-1999

Age Group (Years)		Frequency	Percent
Under 16 yrs	Cut/Pierce	15	.2
	Drowning/Submersion	5	.1
	Fall	3,254	34.9
	Fire/flame	3	.0
	Firearm	40	.4
	Hot Object/substance	2	.0
	MVT/Transport	4,134	44.4
	Bites and stings	15	.2
	Other natural/env	50	.5
	Overexertion	1	.0
	Poisoning	3	.0
	Struck by, against	877	9.4
	Suffocation	5	.1
	Other/Unspecified	512	5.5
	Machinery	13	.1
	Total	8,929	95.9
	Missing	384	4.1
Total	9,313	100.0	
16-64 yrs	Cut/Pierce	163	.4
	Drowning/Submersion	16	.0
	Fall	7,679	17.6
	Fire/flame	27	.1
	Firearm	831	1.9
	Hot Object/substance	9	.0
	MVT/Transport	26,157	60.0
	Bites and stings	2	.0
	Other natural/env	92	.2
	Overexertion	13	.0
	Poisoning	104	.2
	Struck by, against	4,896	11.2
	Suffocation	23	.1
	Other/Unspecified	1,989	4.6
	Machinery	203	.5
	Total	42,204	96.8
	Missing	1,410	3.2
Total	43,614	100.0	
65 yrs+	Cut/Pierce	13	.1
	Drowning/Submersion	1	.0
	Fall	15,055	69.5
	Fire/flame	2	.0
	Firearm	66	.3
	Hot Object/substance	3	.0
	MVT/Transport	4,210	19.4
	Bites and stings	5	.0
	Other natural/env	32	.1
	Overexertion	1	.0
	Poisoning	25	.1
	Struck by, against	416	1.9
	Suffocation	7	.0
	Other/Unspecified	541	2.5
	Machinery	27	.1
	Total	20,404	94.2
	Missing	1,247	5.8
Total	21,651	100.0	

Source: PHC4

Table 6
Mechanism of TBI by Race, Males

Acute Pennsylvania Hospital Discharge Data – 1995-1999

RACE		Frequency	Percent
White	Cut/Pierce	63	.2
	Drowning/Submersion	13	.0
	Fall	10,644	31.3
	Fire/flame	9	.0
	Firearm	339	1.0
	Hot Object/substance	7	.0
	MVT/Transport	16,878	49.6
	Bites and stings	10	.0
	Other natural/env	94	.3
	Overexertion	4	.0
	Poisoning	47	.1
	Struck by, against	2,957	8.7
	Suffocation	15	.0
	Other/Unspecified	1,420	4.2
	Machinery	196	.6
	Total	32,696	96.1
	Missing	1,312	3.9
Total	34,008	100.0	
Black	Cut/Pierce	68	1.1
	Drowning/Submersion	3	.0
	Fall	1,258	20.4
	Fire/flame	12	.2
	Firearm	330	5.4
	Hot Object/substance	1	.0
	MVT/Transport	2,314	37.6
	Bites and stings	2	.0
	Other natural/env	9	.1
	Overexertion	3	.0
	Poisoning	19	.3
	Struck by, against	1,417	23.0
	Suffocation	1	.0
	Other/Unspecified	486	7.9
	Machinery	13	.2
	Total	5,936	96.4
	Missing	224	3.6
Total	6,160	100.0	
Asian or Pacific Islander	Cut/Pierce	3	1.2
	Fall	54	22.2
	Firearm	7	2.9
	MVT/Transport	118	48.6
	Struck by, against	36	14.8
	Other/Unspecified	15	6.2
	Machinery	1	.4
	Total	234	96.3
	Missing	9	3.7
	Total	243	100.0
Other/Unknown	Cut/Pierce	24	.4
	Drowning/Submersion	1	.0
	Fall	1,618	27.0
	Fire/flame	3	.1
	Firearm	153	2.6
	Hot Object/substance	2	.0
	MVT/Transport	2,907	48.5
	Other natural/env	18	.3
	Overexertion	4	.1
	Poisoning	14	.2
	Struck by, against	673	11.2
	Suffocation	6	.1
	Other/Unspecified	314	5.2
	Machinery	22	.4
	Total	5,759	96.1
Missing	236	3.9	
Total	5,995	100.0	

Source: PHC4

Table 7
Mechanism of TBI by Race, Females

Acute Pennsylvania Hospital Discharge Data – 1995-1999

RACE		Frequency	Percent
White	Cut/Pierce	16	.1
	Drowning/Submersion	4	.0
	Fall	10,267	45.9
	Fire/flame	5	.0
	Firearm	64	.3
	Hot Object/substance	3	.0
	MVT/Transport	9,671	43.2
	Bites and stings	8	.0
	Other natural/env	45	.2
	Overexertion	3	.0
	Poisoning	38	.2
	Struck by, against	651	2.9
	Suffocation	10	.0
	Other/Unspecified	569	2.5
	Machinery	9	.0
	Total	21,363	95.5
	Missing	1,004	4.5
Total	22,367	100.0	
Black	Cut/Pierce	13	.5
	Drowning/Submersion	1	.0
	Fall	789	31.6
	Fire/flame	2	.1
	Firearm	29	1.2
	Hot Object/substance	1	.0
	MVT/Transport	1,086	43.5
	Other natural/env	1	.0
	Poisoning	2	.1
	Struck by, against	322	12.9
	Suffocation	2	.1
	Other/Unspecified	144	5.8
	Total	2,392	95.8
	Missing	105	4.2
Total	2,497	100.0	
Asian or Pacific Islander	Fall	46	30.3
	MVT/Transport	90	59.2
	Poisoning	1	.7
	Struck by, against	3	2.0
	Other/Unspecified	5	3.3
	Total	145	95.4
Missing	7	4.6	
Total	152	100.0	
Other/Unknown	Cut/Pierce	4	.1
	Fall	1,311	41.7
	Fire/flame	1	.0
	Firearm	14	.4
	MVT/Transport	1,428	45.4
	Bites and stings	2	.1
	Other natural/env	7	.2
	Overexertion	1	.0
	Poisoning	11	.3
	Struck by, against	128	4.1
	Suffocation	1	.0
	Other/Unspecified	89	2.8
	Machinery	2	.1
	Total	2,999	95.4
Missing	144	4.6	
Total	3,143	100.0	

Source: PHC4

Table 8
Intent of TBI by Sex

Acute Pennsylvania Hospital Discharge Data – 1995-1999

Gender		Frequency	Percent
Males	Unintentional	39,245	84.6
	Self-inflicted	394	.8
	Assault	4,741	10.2
	Undetermined	215	.5
	Other	30	.1
	Total	44,625	96.2
	Missing	1,781	3.8
Total	46,406	100.0	
Females	Unintentional	25,762	91.5
	Self-inflicted	99	.4
	Assault	955	3.4
	Undetermined	83	.3
	Total	26,899	95.5
	Missing	1,260	4.5
	Total	28,159	100.0

Source: PHC4

Table 9
Intent of TBI by Race

Acute Pennsylvania Hospital Discharge Data – 1995-1999

RACE		Frequency	Percent
White	Unintentional	50,959	90.4
	Self-inflicted	356	.6
	Assault	2,534	4.5
	Undetermined	205	.4
	Other	12	.0
	Total	54,066	95.9
	Missing System	2,316	4.1
Total	56,382	100.0	
Black	Unintentional	5,935	68.6
	Self-inflicted	54	.6
	Assault	2,268	26.2
	Undetermined	58	.7
	Other	13	.2
	Total	8,328	96.2
	Missing System	329	3.8
Total	8,657	100.0	
Asian or Pacific Islander	Unintentional	322	81.5
	Assault	56	14.2
	Undetermined	1	.3
	Total	379	95.9
Missing System	16	4.1	
Total	395	100.0	
Other/Unknown	Unintentional	7,802	85.3
	Self-inflicted	84	.9
	Assault	839	9.2
	Undetermined	34	.4
	Other	5	.1
	Total	8,764	95.8
	Missing System	380	4.2
Total	9,144	100.0	

Source: PHC4

Table 10
Sources of Hospital Admissions for TBI

Acute Pennsylvania Hospital Discharge Data – 1995-1999

	Frequency	Percent
Physician Referral	5,443	7.3
Clinic Referral	649	.9
HMO Referral	171	.2
Transfer from Hospital	4,586	6.1
Transfer from Skilled Nursing Facility	464	.6
Transfer from other Health Care Facility	1,694	2.3
Emergency Room	61,501	82.5
Court/Law Enforcement	8	.0
Transfer from Rural Primary Care Facility	54	.1
Total	74,572	100.0
Missing	6	.0
Total	74,578	100.0

Source: PHC4

Table 11
Discharge Status for TBI

Acute Pennsylvania Hospital Discharge Data – 1995-1999

	Frequency	Percent
Outpatient	13	.0
Discharged to home/self-care (routine)	49,959	67.0
Discharged/transferred to short-term general hospital	1,653	2.2
Discharged/transferred to skilled nurse facility	6,182	8.3
Discharged/transferred to intermediate care facility	370	.5
Discharged/transferred to other in/outpatient service	8,416	11.3
Discharged/transferred to home health service org	3,109	4.2
Left ama/discontinued care	887	1.2
Discharged/transferred to homecare provider	5	.0
Discharge - defined at state level	5	.0
Expired	3,952	5.3
Still patient/returning for outpatient services	19	.0
Reserved for national assignment	5	.0
Total	74,575	100.0
Missing	3	.0
Total	74,578	100.0

Source: PHC4

Table 12
Frequencies and Hospital Discharge Rates* for TBI by County

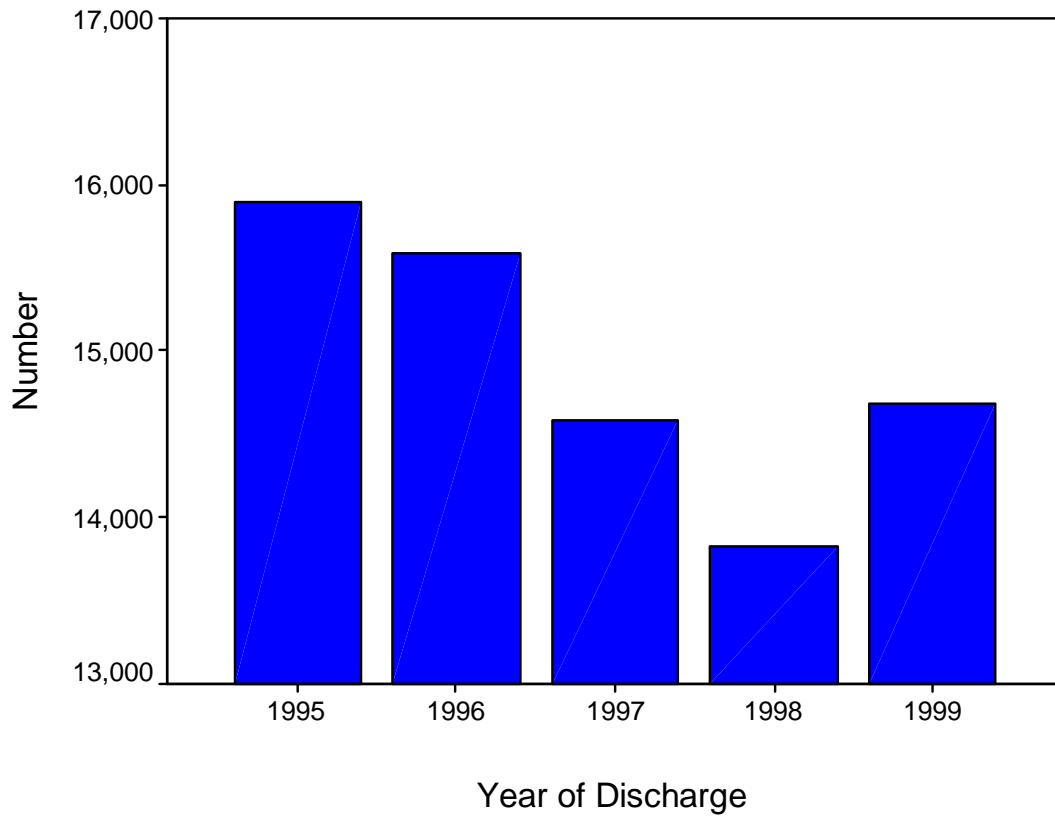
Acute Pennsylvania Hospital Discharge Data – 1995-1999

	Frequency	Rate*		Frequency	Rate*	
Adams	392	91.42		Lackawanna	1,816	172.57
Allegheny	8,741	136.51		Lancaster	2,883	126.99
Armstrong	545	148.15		Lawrence	635	133.07
Beaver	896	96.51		Lebanon	741	126.43
Bedford	250	101.52		Lehigh	1,382	92.84
Berks	1,436	81.12		Luzerne	2,617	164.82
Blair	995	152.00		Lycoming	517	87.33
Bradford	257	82.51		McKean	242	103.41
Bucks	2,920	100.23		Mercer	719	117.83
Butler	928	109.69		Mifflin	249	105.56
Cambria	1,599	203.15		Monroe	657	107.24
Cameron	33	115.40		Montgomery	3,070	86.18
Carbon	388	131.87		Montour	96	106.84
Centre	427	64.21		Northampton	1,323	102.84
Chester	2,133	102.41		Northumberland	543	114.20
Clarion	314	150.17		Perry	285	129.06
Clearfield	544	134.89		Philadelphia	12,129	167.14
Clinton	199	107.90		Pike	117	59.83
Columbia	312	97.15		Potter	50	58.28
Crawford	557	124.72		Schuylkill	956	126.41
Cumberland	886	85.25		Snyder	174	90.91
Dauphin	1,187	96.59		Somerset	695	173.20
Delaware	3,615	133.15		Sullivan	30	98.31
Elk	189	108.28		Susquehanna	379	180.11
Erie	1,332	95.35		Tioga	166	79.78
Fayette	1,186	163.55		Union	188	90.01
Forest	49	199.59		Venango	407	140.18
Franklin	373	58.57		Warren	179	80.94
Fulton	86	118.97		Washington	1,427	138.67
Greene	183	86.71		Wayne	407	179.35
Huntingdon	272	120.43		Westmoreland	2,633	140.55
Indiana	681	152.72		Wyoming	278	189.20
Jefferson	373	160.20		York	2,158	116.49
Juniata	152	138.83		Total	74,578	124.09

Source: PHC4
* Rate per 100,000 population.

Figure 12
Frequency of TBI Discharges by Year of Discharge

Acute Pennsylvania Hospital Discharge Data – 1995-1999



Source: PHC4

Technical Notes and Methods

Definitions

Traumatic Brain Injury – a fracture of the vault, base of the skull, other unqualified skull fracture, a concussion, cerebral laceration and contusion, or intracranial hemorrhage. TBI were identified from the primary diagnosis field and the 8 secondary diagnoses fields.

Table 13
Definitions of Traumatic Brain Injury⁸

ICD-9-CM	Description
800	Fracture of vault of skull.
801	Fracture of base of skull.
803	Other and unqualified skull fractures.
804	Multiple fractures involving skull or face with other bones.
850	Concussion.
851	Cerebral Laceration and contusion.
852	Subarachnoid, subdural, and extradural hemorrhage following injury.
853	Other and unspecified intracranial hemorrhage following injury.
854	Intracranial injury of other and unspecified nature
959.01	Head injury unspecified

Maximum Abbreviated Injury Scale (MAX AIS) – the AIS is a widely used injury severity scoring system that is based primarily on anatomic descriptors of the injury.⁷ It is an ordinal scale that ranges from 1 (minor injury) to 6 (maximum injury, virtually unsurvivable). The MAX AIS was computed from the single primary and eight secondary diagnosis fields. In this report the MAX AIS was derived by automated translation of the ICD-9 diagnoses using the computer software package ICDMAP-90[®] from Tri-Analytics Incorporated. Though the ICDMAP-90 conversion program is not a perfect tool for providing precise information on injury severity, it allows scoring of injury when the number of cases makes it impractical to code medical records. Validation of this program can be found in the journal *Medical Care*.⁷ The ICDMAP-90 program allows for several options. For this report the following settings were used: *LOW SEVERITY*, and *IGNORE UNKNOWNS*. More information on these settings can be found in the ICDMAP-90 User's Guide.⁹

Charges – Hospital charges were defined as the total hospital charges associated with the hospital stay. Because actual payments were made after the hospital discharge, the payer source is actually the expected payer source and not all charges are actually collected.

Rural/urban/mixed – The classifications, "urban", "rural", and "mixed" were derived from Pennsylvania Partnerships for Children in collaboration with the Pennsylvania State Data Center, using population categories and data from the 1990 US Census of Population and Housing. Counties are assigned to one of three categories by the proportion of their 1990 population that was "urban" or "rural": "rural" if 2/3 population was "rural"; "urban" if 2/3 population was "urban"; and "mixed" if population was neither 2/3 "rural" nor 2/3 "urban". Pennsylvania has 12 "urban", 33 "rural" and 22 "mixed" counties.

Substance abuse-related diagnoses - In order to assess the level of alcohol or drug involvement in the assaultive injury dataset, filter syntax was applied to the single primary diagnosis field and eight secondary diagnoses fields. The alcohol filter searched for ICD-9-CM diagnostic codes derived from the National Institute on Alcohol Abuse and Alcoholism,¹⁰ plus four additional codes (790.3, 980.0, E860.0,

E860.1). The drug filter searched for ICD-9-CM diagnostic codes provided by the National Public Service Research Institute.¹¹

Median – In a sample of observations ordered from lowest to highest, the median is the middle observation if n is odd and the average of the two middle observations if n is even.

Mean – The sum of all observations divided by the number of observations. The most common measure of central tendency.

Standard Deviation – The positive square root of the variance.

Variance – The mean square deviation of a continuous distribution.

Limitations of the Data

The 1995-1999 hospital discharge database includes those persons discharged in the year under study. Persons may have been injured in 1994 but not discharged until 1995. Conversely, some persons may have been injured in 1999 and discharged in 2000. Because of the offsetting nature of these temporal situations, no adjustment was made.

The discharge database does not include data from veteran's affairs (VA) hospitals. It is unlikely that a VA hospital would treat an acute injury case; most VA's do not have emergency departments. However, it is possible that a few acute injury cases were treated at a VA hospital and these would not be included in this report.

The hospital discharge database includes persons who may have been admitted to one hospital, discharged to another hospital, and discharged again in the same calendar year. This double counting probably results in an inflation of the incidence count of less than 5 percent (based on reports of multiple hospitalizations in other studies). However, to reduce this error we eliminated cases admitted to a rehabilitation facility for most analysis.

There was no verification of the cause of injuries reported by hospitals in the PHC4 data. While it is possible that some reports of injuries involving the head and/or spinal cord may have been miscoded (false positives), it is also possible that a number of injuries involving the head and/or spinal cord may not have been properly identified and coded correctly (false negatives).

Because the data was derived from hospital billing data, there was no information on other risks and behaviors during the injury event.

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