

Brain Injuries In Iowa 1997-1999:

Inpatient Admissions

Iowa Department of Public Health
Center for Health Statistics
September 2001

Thomas J. Vilsack, Governor
Sally J. Pederson, Lieutenant Governor
Stephen C. Gleason, D.O., Director, Iowa Department of Public Health

Table of Contents

What is a brain injury (BI)?.....	1
State Inpatient Database (SID).....	1
What are the consequences of brain injury?.....	2
How many were injured?.....	3
Who was injured?.....	4
What caused the injuries?.....	6
Motor vehicle injuries.....	7
Motorcycles.....	7
Pedestrians.....	8
Bicycles.....	9
Falls.....	9
Assaults.....	10
How serious were the sustained injuries?.....	11
Discharges from inpatient care.....	11
Average length of stay.....	12
Charges for care.....	12
Who was charged for inpatient care in Iowa?.....	13
Conclusions.....	14
Future prevention interventions.....	15
References.....	18

Brain injury contacts at the IA Department of Public Health are listed on the inside of the back cover.

What is a brain injury?

Under Iowa law, hospitals treating persons with a brain or spinal cord injury which results in a hospital admission, patient transfer, or death must report that injury to the Central Registry for Brain and Spinal Cord Injuries of the Iowa Department of Public Health.* Reportable brain injuries include:

<u>Injury</u>	<u>ICD-9 Code**</u>
• fractures of the vault or base of the skull	800-801
• other skull fractures, multiple fractures of face, skull	803-804
• concussions, cerebral lacerations, intracranial hemorrhage following injury and other traumatic intracranial injuries	850-854
• drownings, submersions, asphyxiations, strangulations;	994.1, 994.7
• anoxic brain damage-only when accompanied by a ICD-9 cause code (ecode).	348.1

Data sources: This report profiles persons with inpatient admissions to an Iowa hospital between 1997 and 1999 who were diagnosed with a brain injury reportable to the Central Registry for Brain and Spinal Cord Injuries. While using the Central Registry's definition of reportable brain injury (BI), this report does not rely on data drawn from the Central Registry. Rather, data is used from Statewide Inpatient Database (SID) which has a more complete count of brain injury admissions. The SID contains data sent electronically by hospitals to the Iowa Hospital Association and provided in turn to the Iowa Department of Public Health.

* Iowa Code, Chapter 135.22 and Iowa Administrative Code, Public Health[641], Chapter 21
The Code defines brain injury as, "the occurrence of injury to the head not primarily related to a degenerative disease or aging process that is documented in a medical record with one or more of the following conditions attributed to the head injury: an observed or self-reported decreased level of consciousness, amnesia, skull fracture, an objective neuropsychological abnormality or diagnosed intracranial lesion.

** *Manual of International Classification of Diseases, Injuries and Causes of Death*, Ninth Edition (ICD-9). While the new ICD-10 coding system was available, Iowa hospitals continued to use the ICD-9 to code inpatient admissions for the years covered by this report, 1997-99.

Many states have brain and spinal cord injury registries similar to the Iowa's. The Centers for Disease Control and Prevention (CDC) encourages that, at a minimum, states undertake surveillance of *traumatic* brain injuries. (Traumatic brain injuries are those coded to 800-801, 803-804, and 850-854 and 873 in the case of deaths.)

While the SID is a more complete database, neither it nor the Central Registry includes data on Iowans with BI who are treated solely in out-of-state hospitals. Based on the assumption that a comparable number of Iowans leave the state as number of non-Iowans enter the state for treatment of a BI, in order to approximate admissions of Iowans, all inpatient admissions, those of Iowans and non-Iowa residents, are counted in the data presented. In 1999, 86.7 percent (n=1799) of BI admissions were of Iowa residents and 11.3 percent (n=230) were of non-Iowa residents.

One drawback to using the SID is that, unlike the Central Registry, it contains no personal identifiers. Without personal identifiers, duplicate admissions for the same BI become hard to identify and, as a result, estimating counts BIs, as opposed to counts of admissions for BI, becomes equally difficult. Thus, this report profiles hospitalizations rather than new cases (incidences) of BI. The SID lists admitting diagnosis and up to nine discharge diagnoses for each admission all of which were used in this report to identify BI-related hospitalizations.

What are the consequences of brain injury?

Each year as a result of having sustained a BI, more than 500 hundred Iowans die while thousands more become permanently disabled. Iowans with significant long-term disability as a result of BI are estimated to number 50,000-55,000 (CDC website, 2001).

A recent study of Iowans who had sustained BI found that 98 percent of those with severe BI reported at least one chronic problem, while 69 percent of those with mild BI did (Shootman, 1998). These findings are consistent with other studies across the country. (Annoni et al., 1992, Masson et al., 1997).

Chronic health problems frequently experienced by survivors of BI include residual: physical (e.g., speech, vision, and seizures), cognitive (e.g., memory deficits, limited concentration, and impaired communication), and behavioral (e.g., depression, mood swings, and reduced interpersonal skills) impairments. Studies of Iowans have found that survivors of more severe BIs have difficulty returning to work (McMordie, et al., 1989) and experience high rates of chronic impairments (Hoyt-Mack Research Associates, 1998). In the Hoyt-Mack study:

- 81 percent reported one or more physical impairment (trouble walking, speaking, dressing, headaches);
- 92 percent reported memory difficulties;
- 64 percent reported problems in organizing daily activities;
- 75 percent reported difficulty making decisions;
- 76 percent reported emotional difficulties; and,
- 84 percent reported learning difficulties.

**How many
were injured?**

Hospitalizations: Nearly 6,500 BI admissions occurred between 1997 and 1999 (Table 1).

Hospitalizations	Year			Total
	1997	1998	1999	
Number	2,328	2,118	2,029	6,475
Number per day	6.4	6.1	5.6	6.0
Rate per 100,000	81.6	74.0	70.7	75.4
Percent of all Admissions	0.65%	0.60%	0.57%	0.62%

Consistent with national trends showing declining rates of BI hospitalization, *the rate of BI admissions in Iowa dropped 13 percent between 1997 and 1999* going from 81.6 to 70.7 per 100,000 population. (Overall, the inpatient admissions rate in Iowa dropped only one percent during these years.) The cause of this rather steep decline cannot be determined from the SID data. In part, this decline may be due to changing admissions criteria for less severe BIs (Thurman and Guerrero, 1996) as well as to a real decline in the incidence of BI as a result of increased traffic safety initiatives, including those to increase the use of seat belts.

About 6 of every 1,000 Iowa admissions were for a brain injury (6,475 of 1,062,181) during the three years reported. In 1999, *traumatic* brain injuries accounted for 96 percent of BI hospitalizations, while *non-traumatic* BIs (submersions, suffocations, and anoxia) accounted for 4 percent.

The 1998 data show that of the 2,118 BI hospitalizations, about 10 percent were readmissions for the same injury.

Incidence: An earlier Iowa Department of Public Health Report, Traumatic Brain Injuries in Iowa: 1996, estimated that 2,205 traumatic brain injuries (TBIs) occurred in the state that year. This estimate of the incidence (new cases) of TBIs that year was based on a review of Iowa death certificates, the SID, and data from the Iowa Central Registry for Brain and Spinal Cord Injury. This incidence estimate was only of the more severe TBIs—those requiring hospitalization or resulting in death. At the CDC National Center for Injury Prevention and Control website, a much simpler method is used to estimate the incidence of these more severe TBIs. CDC sums mortality and hospitalization counts. Using CDC’s method, it is calculated that about 2,400-2,650 BIs occurred in Iowa in each of the three years 1997 through 1999. This estimate includes both traumatic and non-traumatic BI resulting in death or in hospitalization.

Who was injured?

Gender: Both nationally and in Iowa, *males are at significantly greater risk than females* for BI.

For each year 1997 through 1999, the rate of admission in Iowa for BI for males was more than 70 percent higher than for females (Table 2). During that time, the average BI hospitalization rate for males was 96.1 and for females 55.7/100,000 population.

Table 2: BI hospitalization frequency and rate per 100,000 population by sex, 1997-99

Gender	Year						Total		
	1997		1998		1999		#	(rate)	%
	#	(rate)	#	(rate)	#	(rate)			
F	884	(60.3)	809	(55.1)	761	(51.7)	2,454	(55.7)	37.9
M	1,444	(104.0)	1,308	(93.9)	1,264	(90.5)	4,016	(96.1)	62.0
Unkn	0	(0.0)	1	(0.04)	4	(0.14)	5	(0.06)	0.1
Total	2,328	(81.6)	2,118	(74.0)	2,029	(70.7)	6,475	(75.4)	100%

Race: For one in four brain injury admissions, the race of the admitted person was unknown. Of those persons for whom race was known, 95.7 percent were of Caucasian; 2.4 percent were of African-American; and, 1.9 percent were of Native American, Asian, or Pacific Islander descent. Ethnicity was not available from the SID.

The rate of BI admissions in 1999 was highest in African-American males (84.1/100,000) and, paradoxically, lowest in African-American females (28.3/100,000) compared to other race-sex groups. African-American males had a rate of hospitalization 30 percent higher than Caucasian males and about 10 percent higher than Native American/Asian males. In contrast, African-American females had a rate of hospitalization about 30 percent lower than Caucasian females and about 35 percent lower than Native American/Asian females.

Table 3: BI hospitalization frequency, percent, and rate per 100,000 population by race and sex, 1999

Race	Hospitalizations						% of Total Pop.	
	Female		Male		Unkn Gender	Total #		%
	#	(rate)	#	(rate)				
Caucasian	560	(39.4)	869	(64.9)	0	1,429	70.4	94.4
African-American	8	(28.3)	25	(84.1)	0	33	1.6	1.9
Native Am./Asian	10	(42.8)	17	(75.8)	0	27	1.3	3.6
Unknown	183	(12.4)	353	(25.3)	4	540	26.6	
Total	761	(51.7)	1,264	(90.5)	4	2,029	100%	100%

Income and education: Patient income and education data were not available from the SID.

Age: Two findings stood out when admissions were looked at by age and gender:

- Males had higher BI admission rates than females for *every* age group compared, not just for all ages combined; and,
- For both for males and females, age-specific BI admissions rates were highest for young adults age 15-24 and the elderly (65 years and older), (Table 4).

These Iowa findings showing males, young adults and the elderly at greatest risk mirror national data.

Young Males: Males 15-24 years had BI admission rates 2.5 times that of females of the same age and 1.7 times that of Iowa as a whole. They accounted for 7.4 percent of the overall Iowa population in 1999 and 12.7 percent of all BI hospitalizations.

Looking only at persons less than 65 years of age, males 15-24 years comprised 8.7 percent of the population and 19.3 percent of BI hospitalizations.

Elderly: As might be expected, inpatient admissions from many causes, including BI, increase dramatically after age 65. In 1999, the elderly accounted for 15 percent of the Iowa population, 45 percent of all inpatient admissions, and 34 percent of BI admissions.

BI admission rates for both males and females age 65-74 were more than double those of their next younger (55-64 year-old) same-sex cohorts. Admission rates for those 85 and older were more than five times (for males) and nine times (for females) greater than those of their same-sex cohorts who were age 55-64 years (Table 4).

Age	Female		Male		Unkn #	Total		Percent
	#	Rate	#	Rate		#	rate	
<4	38	(42.5)	61	(65.3)		99	(54.2)	4.9
5-14	59	(30.1)	94	(45.6)	1	154	(38.3)	7.6
15-24	97	(47.6)	258	(121.1)	2	357	(85.6)	17.6
25-34	45	(24.9)	149	(84.5)		194	(54.4)	9.6
25-44	66	(30.2)	176	(79.4)		242	(54.7)	11.9
45-54	51	(26.4)	113	(60.6)		164	(42.9)	8.1
55-64	47	(34.5)	79	(62.7)		126	(48.1)	6.2
65-74	77	(67.6)	126	(134.2)		203	(96.7)	10.0
75-84	137	(145.4)	148	(238.7)	1	286	(183.1)	14.0
85+	144	(310.5)	60	(331.1)		204	(316.3)	10.1
Total	761	(51.7)	1,264	(90.5)	4	2,029	(70.7)	100%

What caused the injuries?

As for previous years, for the three years reported here, motor vehicle crashes and falls* continued as the two leading causes of BI hospitalizations. In that time, motor vehicle crashes and falls each accounted for more than 30 percent of all BI admissions. Running a distant third were assaults which accounted for 3.7 percent of BI admissions. (Figures 10-12)

The proportion of BI hospitalizations accounted for by each cause of injury, with minor exception, varied little across the three years. Unfortunately, the SID failed to provide a cause injury for more than 20 percent of BI hospitalizations during those years.

Table 5: BI Hospitalization frequency, percentage, and rate per 100,000 by sex and BI cause, 1999

Cause of brain injury							Total #	% of all BI	
	Female			Male					Unkn #
	#	rate	%	#	rate	%			
Transportation									
Motor vehicle/ Railroad	239	(16.2)	31.4	409	(29.3)	32.4	1	649	31.9
Non-motor vehicle land	23	(1.6)	3.0	38	(2.7)	3.0		61	3.0
Water/air	2	(0.1)	0.3	4	(0.3)	0.3		6	0.2
Falls	283	(19.2)	37.2	345	(24.7)	27.3	1	629	31.0
Assault	19	(1.3)	2.5	55	(3.9)	4.4		74	3.7
Suicide	4	(0.3)	0.5	16	(1.1)	1.3		20	1.0
Poisoning/Medical Mishap	0	(0.0)	0.0	6	(0.4)	0.5		6	0.3
Suffocation/ Foreign body/ Drowning	7	(0.5)	0.9	17	(1.2)	1.3		24	1.2
Other	29	(2.0)	3.8	104	(7.4)	8.2	1	134	6.6
Unknown	155	(10.5)	20.4	270	(19.3)	21.4	1	426	21.0
Total	761	(51.7)	100%	1,264	(90.5)	100%	4	2,029	100%

Nationwide, motor vehicle crashes, falls and assaults are also the leading causes of BI.

*The ICD-9 classification system, used in the SID to classify both injuries and their causes, categorizes external causes of injury into 'ecodes' of more than twenty major categories and hundreds of subcategories. Major categories include: railroad; motor vehicle; non motor vehicle transport; air/water transport; accidental poisonings; medical misadventures; falls; fire; other environmental factors; drownings/submersions; and other accidents (firearms, machines, power equipment); late effects of prior causes; reactions to therapeutics; suicide; assault/homicide; injuries of undetermined intent (accidental or purposeful); legal intervention; and, acts of war.

Gender: In 1999, just as males had higher rates of BI admissions compared to females for all age groups, *males had higher rates of BI admissions than females for all major causes of injury* (Table 5).

Motor Vehicles

For the young and middle-aged, motor vehicles are the single most significant cause of BI requiring inpatient admission. Rates are especially high for young males.

Mode of transport: Of motor vehicle-related BI admissions (n=649) in 1999, the injured person's mode of transport was:

- 72 percent driver/passenger in non-motorcycle motor vehicle;
- 14 percent motorcyclist;
- 6 percent pedestrian; and,
- 3 percent bicyclist.

Gender: In 1999, the rate of motor vehicle-related BI admissions for males compared to females was:

- 4.2 times higher for motorcycle crashes; (5.2 vs 1.2/100,000);
- 2.6 times higher for motor vehicle crashes with bicycles, (1.1 vs. 0.41/100,000; and,
- 1.8 times higher for motor vehicle crashes (other than those involving a motorcycle) which injured the vehicle passenger or driver, (20.1 vs. 11.0/100,000).

Males accounted for 63 percent of all motor vehicle-related BI admissions in 1999 while females accounted for 37 percent (n=409 vs. 239).

Age: With a rate of 47.5/100,000, *young persons ages 15 through 24 had the highest rate of motor vehicle-related BI admissions* of all age groups. They accounted for 30 percent (n=198) of such hospitalizations in 1999 but only 14.5 percent of the Iowa population.

Males ages 15-24 years accounted for 7.4 percent of all Iowans and more than 20 percent of motor vehicle-related BI admissions. Their rate of MV-related admissions (61.9/100,000) was more than double the overall state rate and was 60 percent higher than that of the nearest age-sex cohort specific rate of 38.5/100,000 found for males ages 25-34 years.

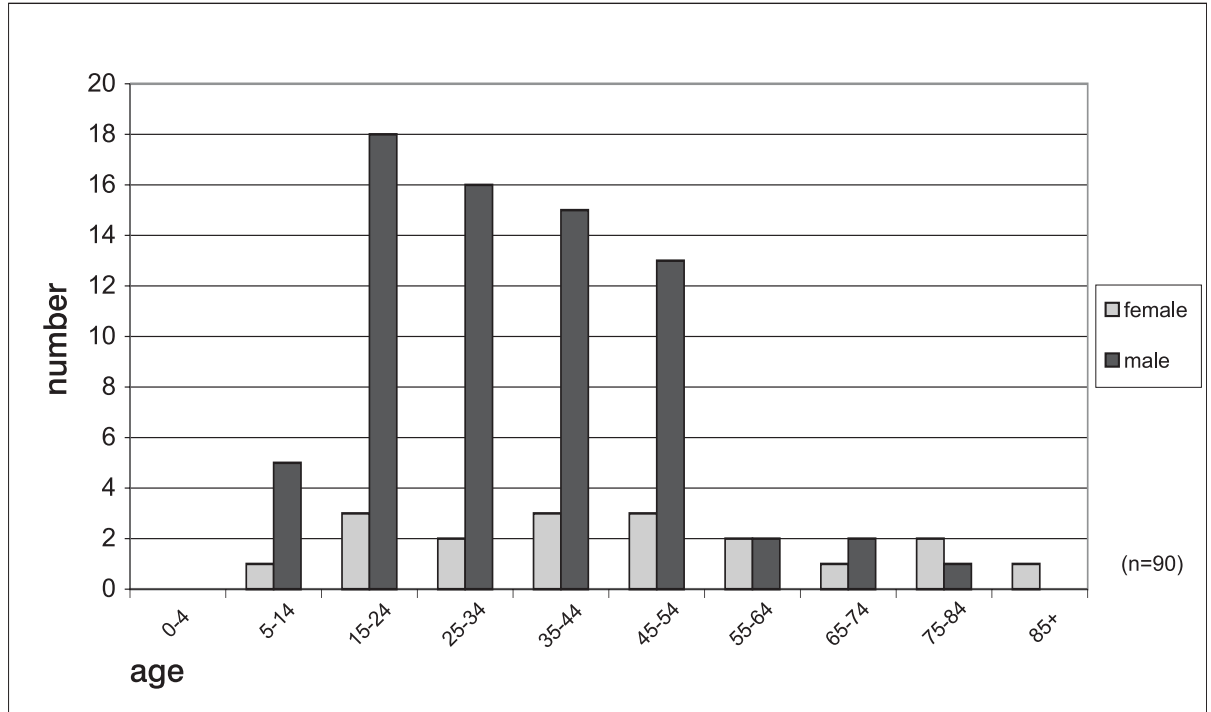
Motorcycles

Sixty-nine percent of admissions for motorcycle-related BIs (62 of 90) in 1999 occurred among males ages 15-54 years who comprised 28 percent of the Iowa population (Figure 1).

The proportion of those hospitalized who were not wearing a helmet at the time of the injury is not known for the three-year period reported. However, for

motorcycle and bicycle-related injuries, it was estimated that 84 percent of those injured in 1996 were not wearing a helmet at the time of injury.

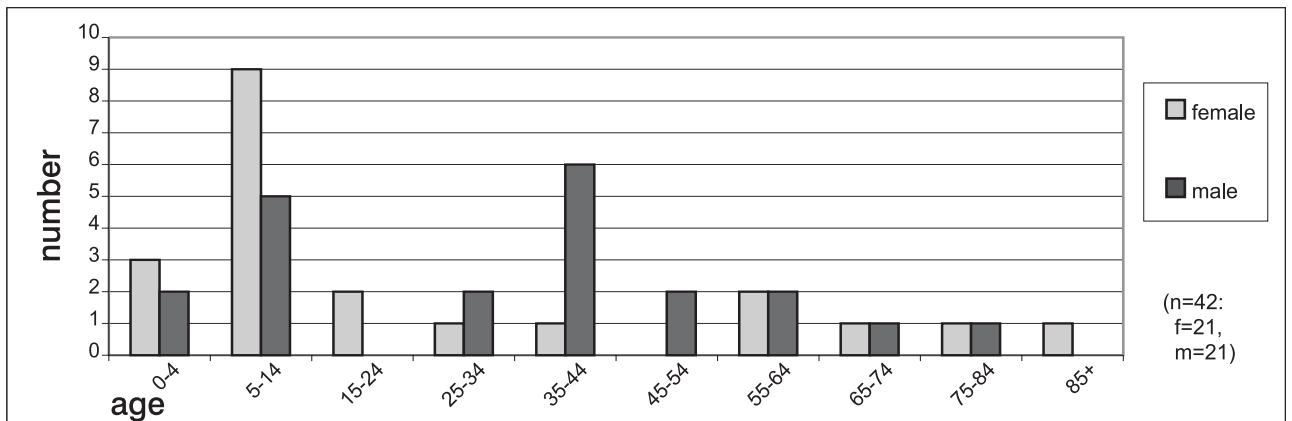
Figure 1: Frequency of BI hospitalizations due to motorcycle crashes by age, by sex, 1999



Pedestrian and Motor Vehicles

In 1999, 93 percent (n=39) of all pedestrian-related BI hospitalizations were the result of pedestrians being hit by motor vehicles. Youth age 5-14 years were most likely to be injured. In contrast to most other causes of injury, female and male pedestrians were equally likely to sustain a BI requiring inpatient admission and *young* females were at greater risk than young males in 1999 (Figure 2).

Figure 2: Frequency of BI hospitalizations due to any pedestrian injury by age by sex, 1999

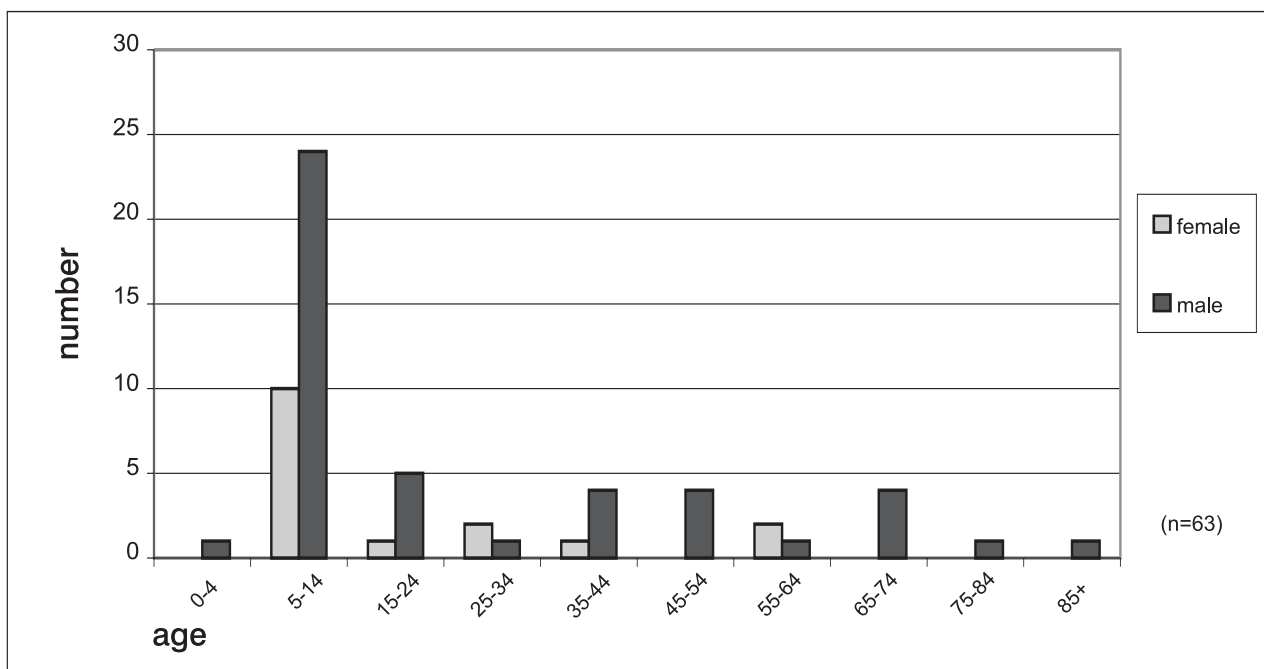


Bicycles

In 1999, half of all of the 63 bike-related BI admissions were motor vehicle-related, while half were not. Bicyclists admitted for BIs were most likely to be children, with children age 5-14 years most at-risk (Figure 3).

Data published in 1996 by the IDPH show that 84 percent of persons injured in bicycle or motorcycle crashes were not wearing a helmet at the time of injury.

Figure 3: Frequency of BI hospitalizations due to any bicycle injury by age by sex, 1999

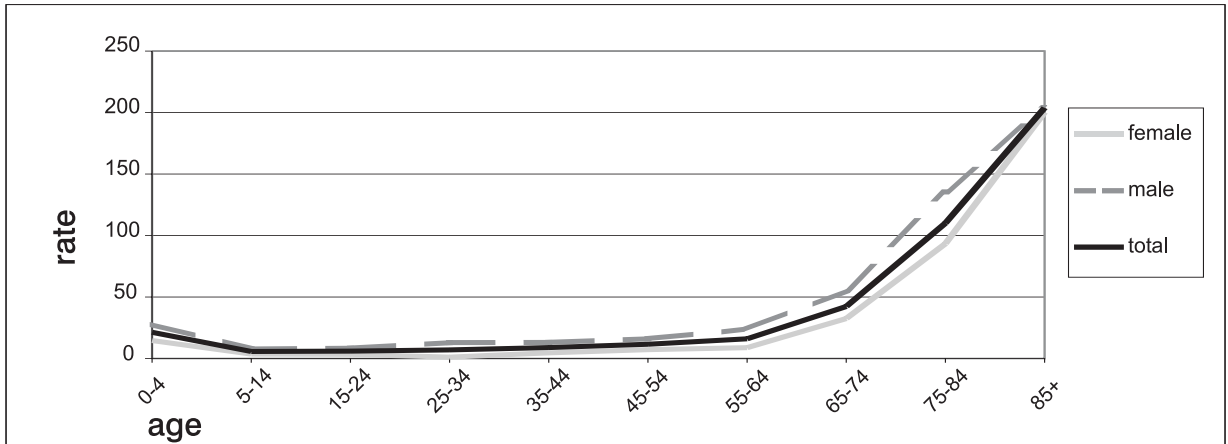


Falls

Falls were the second most frequent cause of BI hospitalizations, accounting for about one of every three BI admission.

Age: Falls occurred most frequently among the elderly. Of fall-related BI hospitalizations in 1999, 62 percent (n=392) occurred among those aged 65 and older while persons in this age group represented just 15 percent of the Iowa population. Twenty-one percent (n=131) of fall-related BI admissions occurred among those 85 and older. This age group accounted for just two percent of the population. The rate of fall-related hospitalizations for those 65 and older was 91.5/100,000 in 1999 (Figure 4).

Figure 4: Rate of BI hospitalizations from falls per 100,000 by age by gender, Iowa, 1999



Gender: More women than men age 65 and older were hospitalized for fall-related BIs in 1999 (218 admissions for women vs. 173 for men). However, men in this age group and in all other age groups had higher *rates* of fall-related BI admissions compared to women (99.4 vs. 85.7/100,000 for those 65 and older; and 24.7 vs. 19.2/100,000 over all ages).

Falls are expected to increase in significance as the percentage of elderly Iowans continues to grow in the coming years.

Assaults

Assaults were the third most frequent cause of BIs, accounting for about 4 percent of hospitalizations in each of the three years 1997-1999 (Figure 5).

Mirroring motorcycle-related BIs, males ages 15-54 years were most at-risk for assaults with 70 percent (n=52) of all assault-related BIs. Young men ages 15-24 were at highest risk accounting for almost one-third of assault-related BIs in 1999.

Figure 5: Frequency of BI hospitalizations due to any assaults, by age by sex, 1999

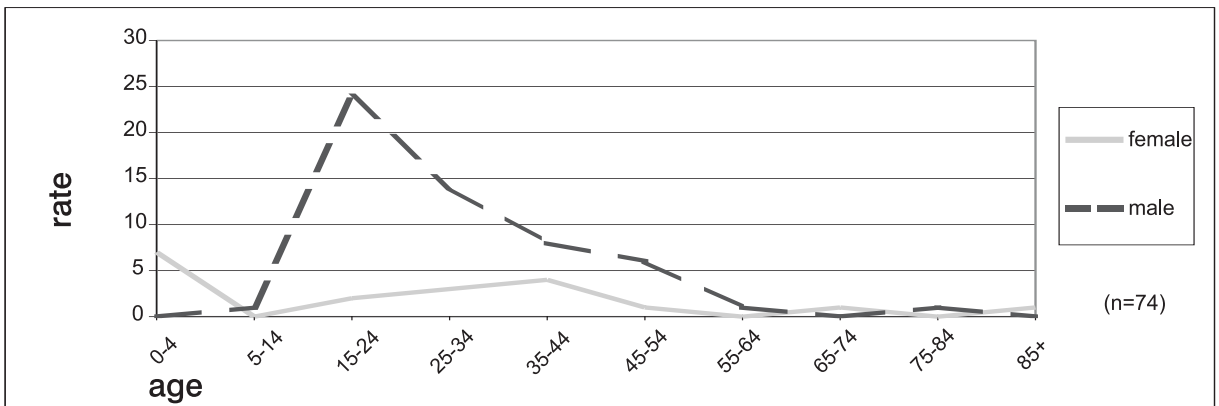
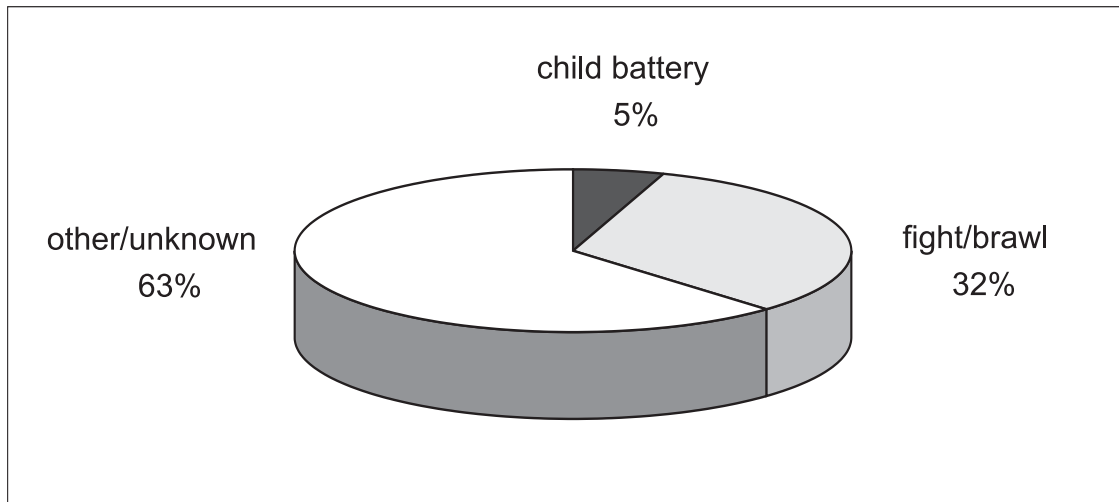


Figure 6: Frequency of BI hospitalizations due to any assaults, by type of assault, 1999



For almost two-thirds of the 74 assaults, type of assault was unknown. Of those of known type, 14 percent (n=4) were from child batteries and 86 percent (n=24) were from fights or brawls.

Surprisingly, firearms were not listed as a cause of injury for any of the 74 assault-related BI admissions in 1999. Firearms were the cause of thirteen BI admissions but these admissions were listed either as unintentional injuries or suicides. Examination of death certificates will be needed to determine how much of a role firearms play in BI injuries apart from those that result in inpatient admission.

How serious were the injuries sustained?

Discharges: home vs. other: Of those 6,475 inpatients admitted with BIs during 1997-1999, 60 percent were sent home (without or without home care); 24 percent went to a nursing, custodial or rehabilitation facility; 9 percent died prior to discharge; and, 6 percent were transferred to another hospital.

Discharge disposition	Percent by year		
	1997	1998	1999
Home to self or relatives	59.1%	55.0%	55.9%
Home with home health care	3.9	4.1	3.1
Transfer to another hospital	6.8	6.2	4.8
Transfer to nursing home	13.7	13.7	14.4
Transfer to rehab facility/group home	6.7	10.6	13.0
Left against medical advice	0.1	0.7	0.3
Died	8.9	9.8	8.4
Unknown	0	0	0
Total	100% (n=2,328)	100% (2,118)	100% (n=2,029)

By cause of injury, the percentage of persons discharged home ranged from 10 percent for suicides to 82 percent for assaults (Table 7).

Discharge disposition	Percent by selected cause of injury, 1999						
	Fall	Motor Vehicle		Pedes- trian MV & Non MV	Bike MV & NonM V	As- sault	Sui- cide
		Driver/ passngr	Motor- cycle				
Home to self or relatives	42.7	65.2	57.8	71.4	81.0	82.4	5.0
Home health care	4.5	1.7	2.2	2.4	0	1.4	5.0
Transfer to another hospital	4.3	9.2	5.6	2.4	3.2	0	25.0
Transfer to nursing home	26.2	0.2	4.4	7.1	6.3	4.1	0
Transfer to rehab/group fac.	12.2	17.1	23.3	11.9	4.8	8.1	25.0
Left against medical advice	0.5	0.2	0	0	0	4.1	0
Died	9.5	6.4	6.7	4.8	4.8	0	40.0
Unknown	0	0	0	0	0	0	0
Total percent	100%	100%	100%	100%	100%	100%	100%
Total number	629	469	90	42	63	74	20

Length of stay (LOS): Of persons with admissions of known cause, those who were passengers or drivers in motor vehicle crashes had both the longest LOS and highest inpatient charges. Passengers and drivers were followed in highest inpatient charges and LOS by motorcyclists and those who fell. Length of stay was longest, almost 11 days for those persons with BI whose cause of injury was not provided in the SID (Table 8).

Selected cause of injury	Average LOS (days)
Falls	6.7
MV: driver/passenger	9.9
MV: motorcycles	6.8
Pedestrian MV & non- MV	6.1
Bicycle: MV and non-MV	5.8
Assault	5.7
Suicide	4.5
Submersions/suffocation/ anoxia	5.0
Unknown cause	10.7
Average LOS all causes (n=2,029)	8.2

What and who were charged for inpatient care?

Average inpatient charges, exclusive of professional fees, emergency department and after care were highest for drivers and passengers sustaining a

BI in a motor vehicle accident (\$30,787) and second highest for those with fall-related BIs (\$23,419) (Table 9). Overall average inpatient charges for BI was \$22,490 and total BI inpatient charges exceeded \$45.6 million in 1999.

Table 9: Average charge for BI hospitalizations by cause of injury, 1999 (n=2,029)

Selected cause of injury	Average inpatient charge
Falls	\$23,419
MV: driver/passenger	30,787
MV: motorcycles	23,264
Pedestrian MV & non- MV	16,830
Bicycle: MV and non-MV	18,194
Assault	14,999
Suicide	16,611
Submersions/suffocation/ anoxia	14,612
Unknown cause	26,614
Average charge all causes	\$22,490

Private insurers, including managed care organizations, were charged the largest share of acute care costs (47.8 percent on average) for injuries requiring hospitalization during the three years, followed by Medicare, ‘self-pay’ and Medicaid (Table 10).

Almost 8 percent of admissions were for persons with no third party coverage and another one to three percent relied on county funds or the state papers program to pay for their care. Thus, BI inpatient care places a heavy financial burden not only on the injured and their families, but on their health care providers and on state and local government.

Average inpatient charges per admission increased 21 percent during the three-year period studied.

Table 10: Percentage of charges for BI hospitalizations by expected source of payment, 1999

Expected source of payment	Percent of charges by year		
	1997	1998	1999
Private insurance/Champus	47.3	37.4	43.8
Private HMO/PPO/managed care	NA	7.4	7.4
Medicare	28.4	31.8	28.3
Medicaid/Medicaid managed care	7.2	7.2	6.8
Self-pay	11.2	11.5	7.7
State/county	2.4	1.3	1.3
Workers compensation	3.3	3.5	4.5
Unknown	0	0	0
Total	100% (n=2,328)	100% (2,118)	100% (n=2,029)
Total average charges	\$18,613	\$19,630	\$22,490

Additional Data Sources:

(Please see the IDPH’s Iowa Health Indicator Tracking System (IHITS) for county specific data on brain injuries: <http://www.idph.state.ia.us>)

Conclusions

Summary:

Inpatient admissions for BI declined during the three years 1997-99. This decline in admissions may be reflect a real decline in the incidence of BI as a result of intensified traffic safety prevention efforts or merely a tightening of inpatient admission criteria for mild BI by insurers. We estimate the annual incidence of more severe BI (BIs resulting in death or hospitalization) to be 2,400-2,650.

Iowa inpatient data show males are more at risk than females for BI for all age groups and for all major causes of injury. Of the causes of brain injury examined, only in the subcategory of pedestrian-related injuries did female risk exceed that of males.

Young persons are especially at risk of BI from motor vehicle, bike and pedestrian injuries, while the elderly are at greatly increased risk of injury from falls and have the highest overall rate of hospitalization for BIs.

Among racial groups, minority males, especially African-American males, are at increased risk compared to Caucasian males, while African-American females have risks lower than that of Caucasian and other minority females.

Motorcycle crashes and assaults, the cause of a significant proportion of BI admissions, largely affect the young and middle-aged, with risk not dropping substantially until age 55.

Limitations:

Limitations on use of the SID for BI surveillance include: the lack of basic demographic information (income, education, ethnicity); missing entries in a substantial portion of admissions for cause of injury and for race; and, the lack of information about use of alcohol and other drugs, seat belt use, weather, at the time of the injury, and any subsequent chronic disability or impairment.

The SID's lack of personal identifiers and lack of records of those Iowans hospitalized outside of the state make estimating incidence rates as opposed to hospitalization rates for injuries difficult, if not impossible without extensive manipulation of multiple data sets with identifiers. Still, along with death certificates, the SID is currently the single most complete source of information for BI surveillance statewide.

In the future, further examination of mortality data from the Bureau of Vital Records of the IDPH and of ambulance runs and emergency department data from State Trauma Registry located within the Bureau of Emergency Medical Services of the Iowa Department of Public Health will be needed.

Prevention interventions

Prevention efforts to reduce the number, severity, and sequelae of brain injuries are key to reducing the significant psychosocial and economic burdens of brain injury on the injured, their families and their communities.

Healthy Iowans 2010, a planning document outlining public health intervention needs over the next ten years, notes that since at least 1993 unintentional injuries have been the leading cause of death for Iowans ages 1-34 (about one-third or 100 of those deaths each year are due to BI). Several chapters of *Healthy Iowans* address prevention and health services interventions to reduce the impact of unintentional and intentional injuries. Objectives contained in those chapters that directly or indirectly address BI include those that seek to:

- assure that all Iowans are served by an effective emergency medical services system;
- reduce falls through better surveillance and progressive resistance training for the elderly so that their functional fitness is improved;
- reduce firearm-related injuries through education in the schools and in the community about proper storage of ammunition and firearms;
- confiscate and store firearms possessed by persons convicted of violent crimes and require all handguns sold in the state to possess mechanisms to prevent anyone but the owner from using them;
- establish better surveillance systems to record firearm injuries, and other violent acts, including victimization of adults and children and school and workplace-based violence;
- screen all substance abuse treatment program clients for domestic abuse and all domestic abusers for substance abuse;
- reduce child abuse through improved respite care, mentoring and other supportive programs;
- increase funding for investigation of elder abuse;
- establish state level task force on school and workplace violence to develop a prevention action plan;
- reduce playground-related injuries through better surveillance, use of national playground safety standards and education of persons responsible for playgrounds;
- decrease motor-vehicle-related fatalities through driver education, increased enforcement of laws regarding drunken driving, child safety restraints and seat belt use;
- reduce head injuries by increasing the use of helmets by bicyclists and motorcyclists, and through motor vehicle prevention education in the primary and secondary schools; and ,
- reduce water-related injuries through increased testing by officers of operators for drug or alcohol consumption, increased supervision of young operators and better drowning reporting.

Figure 7: Rate of BI hospitalization per 100,000 populations, by age, Iowa, 1997

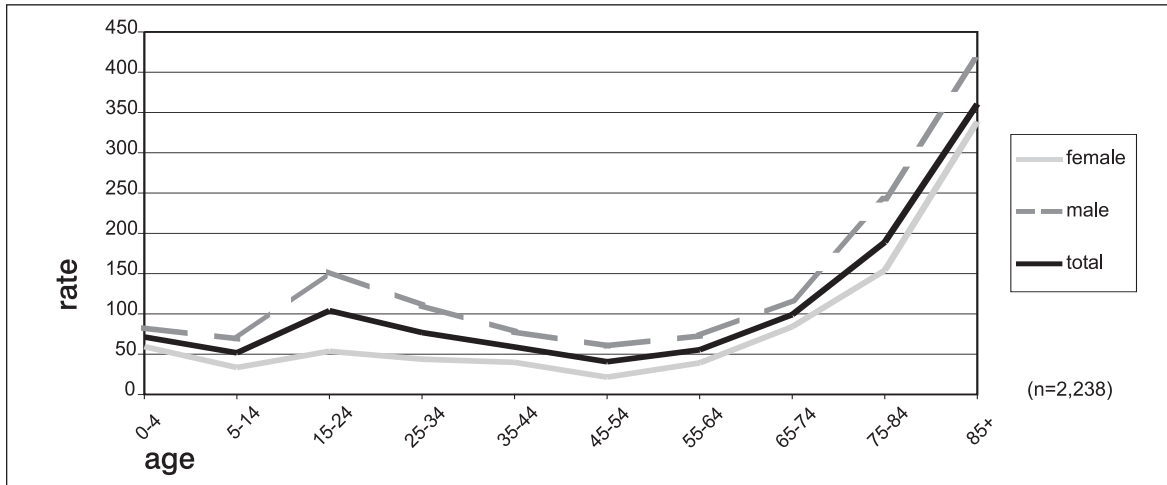


Figure 8: Rate of BI hospitalization per 100,000 populations, by age, Iowa, 1998

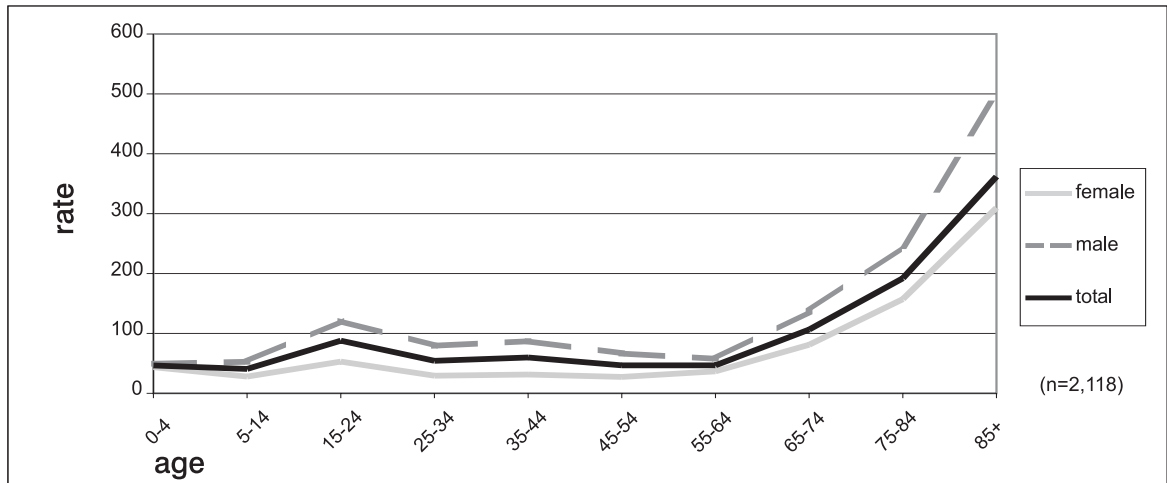


Figure 9: Rate of BI hospitalization per 100,000 population, by age, Iowa, 1999

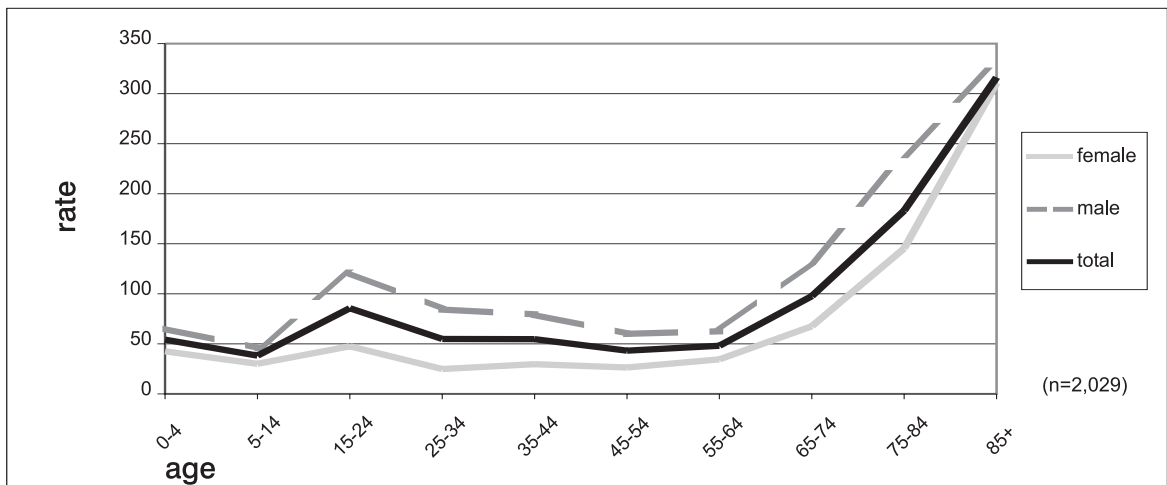


Figure 10: Percentage of BI hospitalizations by cause of injury, 1997

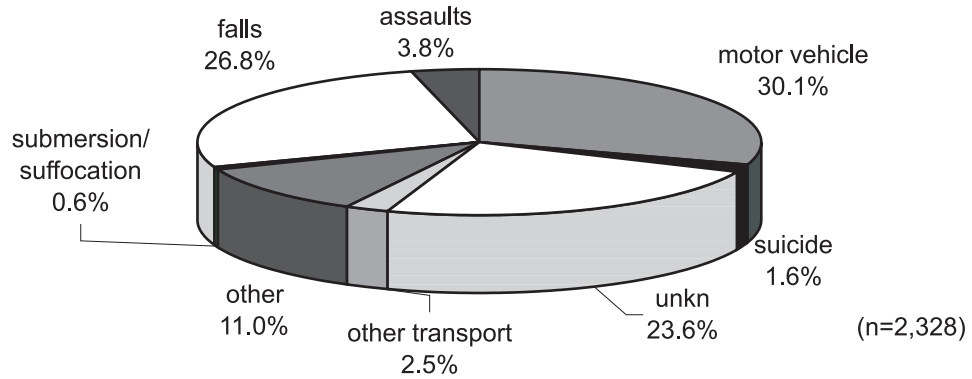


Figure 11: Percentage of BI hospitalizations by cause of injury, 1998

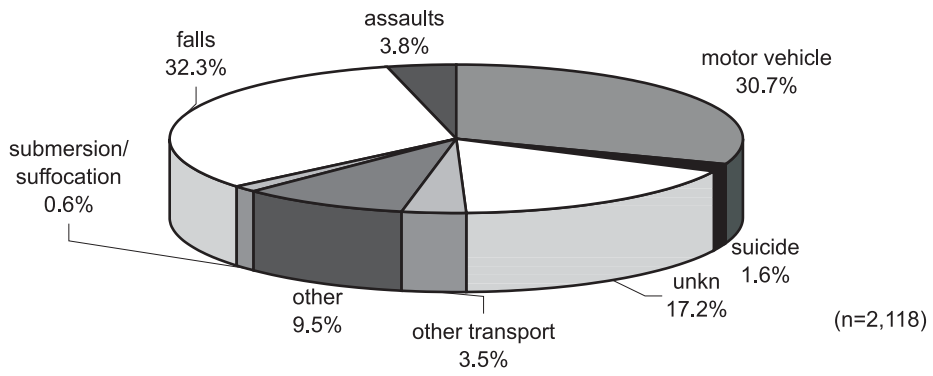
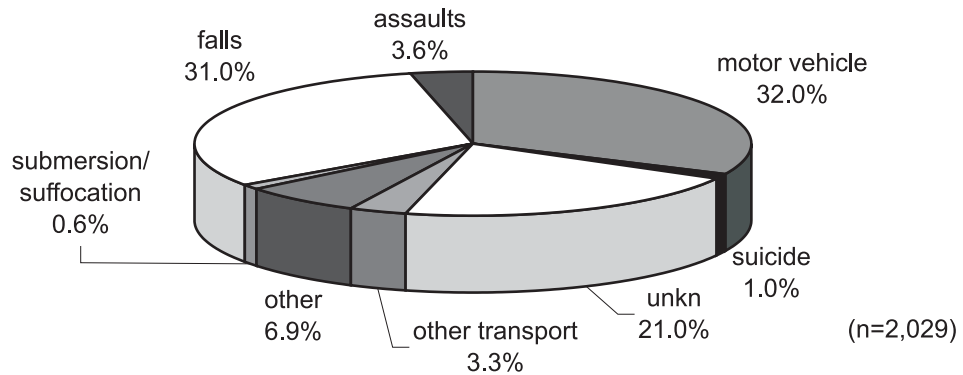


Figure 12: Percentage of BI hospitalizations by cause of injury, 1999



References

Annoni, JM, Beer, S, and Kesselring, J, Severe Traumatic Brain Injury—Epidemiology and Outcome after Three Years, *Disability and Rehabilitation*, Vol. 14, number 1, 23-26, 1992.

CDC Website: www.cdc.gov/hcipc/pub-res/tbicongress.htm

Coming Into Focus: A Needs Assessment and State Plan for Iowans with Brain Injury, Iowa Dept. of Public Health and Iowa Advisory Council on Brain Injuries, 1998.

Hoyt-Mack Research Associates, *Report on Survey of Survivors of Brain Injury and Providers of Brain Injury Services*. Ames, IA, 1998.

Kraus, J and McArthur, D, Epidemiological Aspects of Brain Injury. *Neurologic Clinics*, Vol. 14, number 2, 435-450, 1996.

Masson, F, Saves, M, Salmi, LR, et al., Disabilities and Handicap Five Years after a Head Injury: A Population-Based Study, *Journal of Clinical Epidemiology*, Vol. 50, number 5, 595-601, 1997.

McDordie, WR, Barker, SL, and Paolo, TM, Return to Work (RTW) after head injury. *Brain Injury*. Vol 4, number 1, 57-69, 1990.

Shootman, M, *Report on Life After Head Injury: A Questionnaire*, Iowa Dept. of Public Health, Des Moines, Iowa, 1998.

Contacts for brain injury prevention and control programs of the Iowa Department of Public Health:

Thomas Brown, Program Manager
Brain Injury Prevention Program
Phone: 515/281-6283 email: Tbrown@health.state.ia.us

Roger Chapman, Chief
Bureau of Disability and Injury Prevention
Phone: 281-6646 email: Rchapman@IDPH.state.ia.us

Joann Muldoon, Epidemiologist
Center for Health Statistics
Phone: 515/242-5849 Email: Jmuldoon@IDPH.state.ia.us

This report was prepared by the Center for Health Statistics of the IDPH:

Lead Staff

Joann Muldoon, M.S., M.A.
Don Shepherd, Ph.D.

Staff of the Center for Health Statistics:

Jude Igbokwe, Ph.D., Director
Xia Chen, D.D.S., M.S.
Michael Dare, BS
Jessica Davila, Ph.D.
Joann Muldoon, M.S., M.A.
Don Shepherd, Ph.D.
Rebecca Schmidt, M.S.
Pierce Wilson, M.S.W.

Cooperating Staff of the Bureau of Emergency Medical Services:

Gary Ireland, Bureau Chief
Dick Harmon, Trauma Registry Manager