RUNNING HEAD: Pediatric TBI

A Study of the Epidemiology of Pediatric Traumatic Brain Injury Using the Indiana Trauma Registry

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Introduction

Traumatic brain injury (TBI) physically affects the pediatric population differently than the adult population due in part to differences in body size and proportion. Anatomical and physiological differences of children include:

- greater head-to-body ratio;
- thinner cranial bones which offer less protection to the brain;
- increased vulnerability of brain cells due to lesser maturity;
- malignant edema is more common because increased intracranial pressure is more frequent;
- diffuse cerebral swelling is much more common than mass lesion (as in adults).

(Mazurek, 1994). Like adults, children who survive TBI may be left with impairment(s) in "cognition; language; memory; attention; reasoning; abstract thinking; judgment; problem-solving; sensory, perceptual, and motor abilities; psycho-social behavior; physical functions; information processing; and speech" (http://www.birf.info/home/library/pediatrics/ped_chiltrau.html). In fact, more than 30,000 pediatric TBI survivors experience lifelong disabilities (http://www.birf.info/home/library/pediatrics/ped_chiltrau.html).

The epidemiology of TBI in Indiana and in the United States for the pediatric population (<1 – 17 years of age) has hardly been investigated. A PubMed search by *pediatric traumatic brain injury* yielded 1206 results; of these, only nine were found to be directly related to epidemiological research (Bowman, Bird, Aitken & Tilford, 2008; Day, Roesler, Gaichas & Kinde, 2006; Kim, Wang, Griffith & Summers, 2000; Hartman et al., 2008; Keenan & Bratton, 2006; Leventhal, Martin & Asnes, 2008; Reid, Roesler, Giachas & Tsai, 2001; Schneier, Shields, Hostetler, Xiang, & Smith, 2006; Xiang, Sinclair, Yu, Smith & Kelleher, 2007). Most of the literature dealing with pediatric TBI concerns treatment and rehabilitation, not epidemiology. The lack of epidemiological research into pediatric TBI is puzzling since the leading causes of TBI are injury-related: falls (39%), motor vehicle accidents (11%) and assaults (4%) (unknown causes account for 5% and 'other' accounts for 41% in this population) (http://www.cdc.gov/ncipc/pub-res/TBI_in_US_04/TBI%20in%20the%20US_Jan_2006.pdf). Injury is the leading cause of death for both sexes and all races of this population nationally as well as in Indiana according to WISQARS (Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System) data. In 2005 (the most recent year for which data is available) in Indiana the first leading cause of death for the population aged 1 - 17, both sexes and all races, was unintentional injury [n=192]; for the <1 age group, unintentional injury was the fifth leading cause of death [n=48] (http://webappa.cdc.gov/sasweb/ncipc/leadcaus10.html). These figures mirror national data: unintentional injury is the first leading cause of death [n=8040] for those aged 1 - 17; for the <1 year old age group, unintentional injury is the sixth leading cause of death [n=900] (http://webappa.cdc.gov/sasweb/ncipc/leadcaus10.html). This is in addition to 37,000 hospitalizations and 435,000 emergency department visits nationwide for pediatric TBI patients (http://www.cdc.gov/ncipc/tbi/TBI.htm). As of 2005 for both sexes, all races, for the 1 – 17 year age group in Indiana there were 918.79 years of potential life lost (YPLL) (age adjusted to 2000 standard) due to unintentional injury; this is significantly higher than the US 889.34 YPLL rate for the same population (http://webappa.cdc.gov/sasweb/ncipc/ypll.html).

Schneier, Shields, Hostetler, Xiang, and Smith (2006) contend that pediatric TBI is “a substantial contributor to the health resource burden in the United States, accounting for more than $1 billion in total hospital charges annually” (Schneier et al., 2006, p.483).

Geographic patterning of TBI in the pediatric population was investigated by Reid et al. and demonstrated increased TBI proportionally by nonmetropolitan occurrence (Reid, Roesler, Giachas & Tsai, 2001). However, Sumich, Nelson and McDeavitt found increased incidence of TBI for those “living in congested residential areas” (Sumich, Nelson & McDeavitt, 2007, p. 305).

Given these statistics and costs and the fact that injury is a Healthy People 2010 leading indicator priority for action (http://www.healthypeople.gov/LHI/Priorities.htm), there is a clear need for further epidemiological research into TBI injury within the pediatric population.

Objectives

The objectives of this study were to review 2007 data from the Indiana Trauma Registry and Indiana death certificates to compare incidence of pediatric traumatic brain injury in Indiana for metropolitan versus non-metropolitan areas.

Methods

A retrospective cross-sectional study design was utilized. Data was collected for 2007 from the Indiana Trauma Registry. Records were extracted from the registry retrospectively for pediatric (ages <1 – 17 years) traumatic brain injury cases treated at Clarian Riley Hospital, a level I trauma center in Indianapolis, Indiana specializing in pediatric care. Cases were established from those records by ICD-9-CM codes corresponding with most frequent and typical diagnoses of traumatic brain injury: 800.00 – 801.99, 803.00 – 804.99, and 850.00 to 854.19. Only hospitalized patients or those who expired as a result of the aforementioned injury were included in analysis, not those seen only in the emergency department and subsequently released. The following variables were extracted from registry records:

injury related– which county injury occurred in; injury date and time; ICD-9-CM cause of injury description; ICD-9-CM diagnosis code; trauma type; intentionality;

hospital related – number of days ventilated; number of intensive care unit (ICU) days; hospital discharge date; discharge disposition;

patient related– age; sex; race, trauma registry record number.

Pediatric deaths which occurred on-scene, pre-hospital and which were attributed to TBI were also included in the dataset to account for total TBI cases within Indiana in 2007.

Data was encoded in an Excel spreadsheet and then analyzed using descriptive analysis techniques and SAS 9.1 software.

Results were compared for Indiana metropolitan vs. non-metropolitan areas (as defined by STATS Indiana, a collaboration of the Indiana Business Research Center [Indiana University] and the State of Indiana (http://www.stats.indiana.edu/). Hoosier metropolitan regions consist of the following county areas (table 1):

METROPOLITAN AREA	**COUNTIES**	**PEDIATRIC POPULATION**
Anderson, IN	Madison	29,726
Bloomington, IN	Green, Monroe, Owen	39,656
Cincinnati-Middletown, OH-KY-IN	Dearborn, Franklin, Ohio	19,203
Columbus, IN	Bartholomew	18,662
Elkhart-Goshen, IN	Elkhart	55,550
Evansville, IN-KY	Gibson, Posey, Vanderburgh, Warrick	68,649
Ft. Wayne, IN	Allen, Wells, Whitley	108,188

Gary-Chicago-Naperville, Joliet, IL-IN-WI	Jasper, Lake, Newton, Porter	176,677
Indianapolis, IN	Boone, Brown, Hamilton, Hancock, Hendricks, Johnson, Marion, Morgan, Putnam, Shelby	447,866
Kokomo, IN	Howard, Tipton	23,848
Lafayette, IN	Benton, Carroll, Tippecanoe	45,966
Louisville, KY-IN	Clark, Floyd, Harrison, Washington	57,634
Michigan City-LaPorte, IN	LaPorte	25,207
Muncie, IN	Delaware	25,641
South Bend-Mishawaka, IN	St. Joseph	68,952
Terre Haute, IN	Clay, Sullivan, Vermillion, Vigo	38,887

Table 1

Non-metropolitan areas consist of the remaining counties within Indiana (table 2):

COUNTY	**PEDIATRIC POPULATION**
Adams	9,929
Blackford	2,894
Cass	9,590
Clinton	8,657
Crawford	2,475
Daviess	8,305
Decatur	6,334
Dekalb	10,778
Dubois	10,152
Fayette	5,502
Fountain	3,997
Fulton	4,787
Grant	15,538
Henry	10,315
Huntington	8,910
Jackson	10,259
Jay	5,457
Jefferson	7,495
Jennings	7,195
Knox	8,641
Kosciusko	19,468
Lagrange	11,688
Lawrence	10,289
Marshall	12,031
Martin	2,289
Miami	8,170
Montgomery	9,032

Noble	12,588
Orange	4,675
Parke	3,508
Perry	3,878
Pike	2,810
Pulaski	3,195
Randolph	5,921
Ripley	7,038
Rush	4,213
Scott	5,697
Spencer	4,671
Starke	5,564
Steuben	8,026
Switzerland	2,195
Union	1,688
Wabash	7,240
Warren	1,943
Wayne	15,633
White	5,598

Table 2

Frequencies, proportions and incidence of TBI in the pediatric populations of metropolitan and non-metropolitan areas was calculated; chi-square analysis was performed using SAS 9.1 software to determine if an association existed between selected variables and discharge disposition.

Results

The Indiana Trauma Registry yielded 1,584 records of trauma in the Hoosier pediatric population. Initially, 1,188 records were deleted due to being outside the ICD-9-CM code range for head injury; 49 records were eliminated for not containing data as to the county location where the injury occurred or for not containing an ICD-9-CM diagnosis code; 93 represented duplicate records, which were also eliminated. Of the remaining records, 2 were eliminated due to having *age* recorded as 21 and 22 (one record had two diagnoses recorded; the other had three diagnoses recorded, resulting in elimination of 5 total records). The final record count for analysis (n=181) was determined after elimination of 68 more records representing recording of multiple trauma diagnoses. When the 63 pre-hospital, on-scene pediatric deaths due to TBI were factored in, the total number of pediatric TBI for 2007 was 244.

Descriptive analysis revealed that TBI was experienced in the 1 – 4 age group far more than other age groups (n=244, see table 3 and figure 1):

Age	Freq	Prop
<1	7	2.87
1 to 4	92	37.70
5 to 9	50	20.49
10 to 14	47	19.26
15 to 17	48	19.67
	244	100.00

Table 3

Males were represented nearly one and one half times as often as females (n=242, see table 4 and figure 2):

	Freq	Proportion
Male	141	58.3
Female	101	41.7
	242	100.0

Table 4

White children were included far more than other races which is to be expected given Indiana's overall pediatric population profile (84% white, 11% black, 1% Asian, and 4% other; [*note:* these figures exclude pre-hospital mortality data which included only white, black, and other – Asian race data were excluded]) (Indiana State Department of Health) (n=167, see table 5 and figure 3):

Race	Frequency	Proportion
Asian	2	1.2
Other	8	4.8
Black	18	10.8
White	139	83.2
	167	100.0

Table 5

The most common month of the year for TBI to occur was July. Traumatic brain injury was nearly one and one third times more likely to occur in July than in the next most common month, August (n=165, see table 6 and figure 4):

Month	Frequency	Proportion
January	11	6.7
February	5	3.0
March	13	7.9
April	14	8.5
May	13	7.9
June	14	8.5
July	26	15.8
August	19	11.5
September	17	10.3
October	13	7.9
November	9	5.5
December	11	6.7
	165	100.0

Table 6

The most common time of day for TBI to occur was between the hours of 12:00 noon to 6:00 p.m.; slightly over 86% of TBI incidents occurred from 12:00 noon to midnight (n=131, see table 7 and figure 5):

Time of Day	Frequency	Proportion
6:00 a.m. - 12:00 noon	14	10.7
12:00 noon-6:00 p.m.	59	45.0
6:00 p.m. - 12:00 p.m.	54	41.2

12:00 p.m.- 6:00 a.m.	4	3.1
	131	100.0

Table 7

Over 90% of the children spent 3 or less days in the intensive care unit but in two cases over 50 days each were spent in the ICU (see table 8 and figure 6):

ICU days	Frequency	Proportion
0 to 3	153	91.1
4 to 7	2	1.2
8+	13	7.7
	168	100.0

Table 8

Discharge data revealed that nearly 80% of children were sent home with no other services required (n=172, see table 9 and figure 7):

Discharge Disposition	Frequency	Proportion
Home/no services	136	79.1
Acute care hospital	2	1.2
Rehabilitation or long-term facility	27	15.7
Skilled nursing facility	3	1.7
Expired	4	2.3
	172	100.0

Table 9

Since discharge disposition was being used as a proxy for injury severity, further descriptive analysis was performed. These analyses are summarized in table 10:

Discharge Disposition			Frequency	Proportion
Home/no services				
	Sex			
		Male	81	60.00
		Female	55	40.00
	Age			
		<1	61	44.85
		1 to 4	33	24.26
		5 to 9	27	19.85
		10 to 14	27	19.85
		15 to 17	14	10.29
	Race			
		White	106	84.13
		Asian	2	1.59
		Black	12	9.52
		Other	6	4.76
	Metropolitan		129	79.63
	Non-metropolitan		33	20.37
Acute care hospital				
	Sex			
		Male	1	50.00
		Female	1	50.00
	Age			
		<1	0	0.00
		1 to 4	1	50.00
		5 to 9	0	0.00
		10 to 14	1	50.00
		15 to 17	0	0.00
	Race			
		White	2	100.00
		Asian	0	0.00
		Black	0	0.00
		Other	0	0.00
	Metropolitan		2	100.00
	Non-metropolitan		0	0.00

Skilled nursing facility			
Sex			
	Male	1	33.00
	Female	2	67.00
Age			
	<1	0	0.00
	1 to 4	3	100
	5 to 9	0	0.00
	10 to 14	0	0.00
	15 to 17	0	0.00
Race			
	White	3	100.00
	Asian	0	0.00
	Black	0	0.00
	Other	0	0.00
Metropolitan		3	100.00
Non-metropolitan		0	0.00
Rehabilitation or long-term facility			
Sex			
	Male	15	56.00
	Female	12	44.00
Age			
	<1	0	0.0
	1 to 4	15	55.6
	5 to 9	6	22.2
	10 to 14	5	18.5
	15 to 17	1	3.7
Race			
	White	18	72
	Asian	0	0.00
	Black	5	20
	Other	2	8
Metropolitan		24	85.19
Non-metropolitan		3	14.81

Expired			
Sex			
	Male	3	75.00
	Female	1	25.00
Age			
	<1	0	0
	1 to 4	1	25
	5 to 9	1	25
	10 to 14	2	50
	15 to 17	0	0
Race			
	White	3	100.00
	Asian	0	0.00
	Black	0	0.00
	Other	0	0.00
Metropolitan		4	100.00
Non-metropolitan		0	0.00

Table 10

Frequencies and percentages were calculated for cause of injury and the top five caused were ranked (n=181, see table 11 and figure 8):

Cause	Frequency	Proportion	Rank
Abuse	15	8.29	3
Accident Cutting Instrument Other	1	0.55	
Accident Hot Liquid/steam	1	0.55	
Boating Accident Injury	1	0.55	
Diving Accident	2	1.10	
Fall	85	46.96	1
Injury Other	1	0.55	
Motor vehicle accident	40	22.10	2
Nontraffic boarding/alighting	1	0.55	
Off road motor vehicle accident	8	4.42	5
Pedal cyclist accident	4	2.21	
Fire	1	0.55	
Ridden animal accident	1	0.55	
Strucky by/against	11	6.08	4
Submersion	1	0.55	
Suicide	1	0.55	
Undetermined circumstances	7	3.87	

Table 11

Frequencies, proportions and incidence rates were calculated for metropolitan and non-metropolitan areas of the state. Total number of TBI incidents for the state was 244; incidence rate was 15.37 per 100,000. In metropolitan areas there were 196 TBI incidents or 80%; incidence rate was 15.68 per 100,000. The number of incidents for non-metropolitan areas was 48 or 20%; incidence rate was 14.27 per 100,000. Descriptive analysis for metropolitan and non-metropolitan areas is summarized in tables 12 and 13:

Metropolitan

County	Frequency	IR/100,000
ALLEN	6	6.40
BARTHOLOMEW	3	16.07
BENTON	0	0.00
BOONE	0	0.00
BROWN	0	0.00
CARROLL	1	21.73
CLARK	1	3.99
CLAY	2	31.47
DEARBORN	1	8.17
DELAWARE	3	11.70
ELKHART	2	3.60
FLOYD	0	0.00
FRANKLIN	0	0.00
GIBSON	1	13.01
GREENE	2	26.68
HAMILTON	3	3.94
HANCOCK	4	24.21
HARRISON	0	0.00
HENDRICKS	9	26.01
HOWARD	5	24.70
JASPER	0	0.00
JEFFERSON	0	0.00
JOHNSON	5	14.40
LAKE	9	7.06
LAPORTE	0	0.00
MADISON	5	16.82
MARION	71	30.45
MONROE	2	7.36

MORGAN	6	35.31
NEWTON	0	0.00
OHIO	0	0.00
OWEN	1	20.11
PORTER	1	2.62
POSEY	0	0.00
PUTNAM	5	60.08
ST. JOSEPH	6	8.70
SHELBY	2	19.03
SULLIVAN	0	0.00
TIPPECANOE	13	33.19
TIPTON	4	110.83
VANDERBURGH	6	14.50
VERMILLION	5	136.17
VIGO	9	36.85
WARRICK	1	7.33
WASHINGTON	0	0.00
WELLS	1	17.86
WHITLEY	1	12.64
TOTAL	196	15.68

Table 12

Non-metropolitan

County	Frequency	IR/100,000
ADAMS	2	20.14
BLACKFORD	0	0.00
CASS	0	0.00
CLINTON	1	11.55
CRAWFORD	1	40.40
DAVIESS	0	0.00
DECATUR	3	47.36
DEKALB	1	9.28
DUBOIS	2	19.70
FAYETTE	2	36.35
FOUNTAIN	1	25.02
FULTON	2	41.78
GRANT	3	19.31
HENRY	3	29.08
HUNTINGTON	2	22.44
JACKSON	0	0.00
JAY	1	18.33
JEFFERSON	0	0.00

JENNINGS	2	27.80
KNOX	3	34.71
KOSCIUSKO	0	0.00
LAGRANGE	3	25.66
LAWRENCE	1	9.72
MARSHALL	0	0.00
MARTIN	1	43.69
MIAMI	0	0.00
MONTGOMERY	1	11.07
NOBLE	0	0.00
ORANGE	0	0.00
PARKE	1	28.51
PERRY	0	0.00
PIKE	3	106.76
PULASKI	0	0.00
RANDOLPH	0	0.00
RIPLEY	0	0.00
RUSH	1	23.74
SCOTT	0	0.00
SPENCER	1	21.41
STARKE	2	35.95
STEUBEN	1	12.46
SWITZERLAND	1	45.55
UNION	1	59.24
WABASH	0	0.00
WARREN	0	0.00
WAYNE	1	6.40
WHITE	1	17.86
TOTAL	48	14.27

Table 13

Incidence rates per 100,000 were calculated for each metropolitan area; results are summarized in table 14:

Metropolitan area	IR/100,000
Cincinnati	5.21
Elkhart	3.60
Louisville	1.74
Michigan City	0.00
South Bend	8.70
Ft Wayne	6.47
Gary	5.66

Columbus	16.08
Evansville	11.65
Muncie	11.70
Bloomington	12.61
Anderson	16.82
Indianapolis	23.44
Lafayette	30.46
Kokomo	46.13
Terre Haute	41.14

Table 14

SAS 9.1 software was used to calculate p-values based upon chi-square testing. The variables that demonstrated statistical significance in relation to discharge disposition were time of day of TBI occurrence, number of days spent in ICU, and cause of injury. Results of chi-square tests are summarized in table 15:

Variable	p-value
Metropolitan/non-metropolitan location	0.8736
County	0.9955
Month	0.2383
Time of day	<.0001
ICU days	<.0001
Age	0.9408
Sex	0.8332
Race	0.9912
Cause	<.0001

Table 15

SAS 9.1 software was also used to calculate the mean for age (6.49) and the mean for number of days spent in ICU (2.35).

In 2007, 63 pediatric deaths were attributed to traumatic brain injury (these deaths occurred prior to being transported to a hospital). The results parallel the findings detailed for pediatric TBI injuries with the exception of age: the majority of victims were male; the most common age group in which death occurred was 15 – 17 years of age; white children experienced death more than other races; nearly five times as many instances of TBI resulting in death occurred in metropolitan areas (see table 16).

Variable	Frequency	Proportion
Sex: male	36	57
Sex: female	27	43
Age: <1	6	10
Age: 1-4	10	16
Age: 5-9	6	10
Age: 10-14	8	13
Age: 15-17	33	52
Race: White	55	87
Race: Black	6	10
Race: Other	2	3
Location: Metropolitan	52	83
Location: Non-metropolitan	11	17

Table 16

Discussion

There were more than four times as many instances of pediatric TBI in metropolitan areas of Indiana in 2007, yet the incidence of pediatric TBI is similar between non-metropolitan areas (14.27 per 100,000) of Indiana and metropolitan areas (15.68 per 100,000). Of the 16 designated metropolitan areas within the state, only one experienced no cases of pediatric TBI; in the remaining 11 areas incidence rates ranged from 1.74 to 46.13 per 100,000. The top three leading causes of pediatric TBI in Indiana in 2007 were identical to the national leading causes of pediatric TBI in 2006: 1, falls; 2, motor vehicle accidents; 3, assaults. The most statistically significant associations in relation to discharge disposition were time of day of TBI occurrence, cause of injury, and number of days spent in the intensive care unit. In regard to discharge disposition, of the four cases resulting in death 100% occurred in a metropolitan area. Of those cases in which the patient was discharged to a rehabilitation or long-term facility, over 85% occurred in a metropolitan area; cases discharged to skilled nursing facilities occurred 100% in metropolitan areas. The two cases discharged to acute care hospitals also occurred in metropolitan areas. Finally, of Indiana's 92 counties there are 15 (16.30%) counties without an acute care hospital. Over half of these counties are not in metropolitan areas: Fountain, Parke, Crawford, Martin, Pike, Spencer, Switzerland, and Union. Each of these counties had one case of pediatric TBI in 2007; Pike County had three cases. All of the cases except one from Parke County were discharged home with no further services required. The Parke County case was discharged to a rehabilitative or long-term hospital.

Based upon the data extracted from the Indiana Trauma Registry for inpatient pediatric cases treated at Clarian Riley Hospital in 2007, Indiana may want to increase pediatric traumatic brain injury educational programs and other types of interventions for both metropolitan and non-metropolitan residents since incidence rates are similar among the two areas (15.68 *vs*. 14.27, respectively). Efforts might initially be concentrated upon the Kokomo metropolitan area since the incidence rate for that area was over three times as high as the statewide incidence rate (46.13 *vs*. 15.37). Two apparent areas for vigilance and improvement in Indiana include keeping children as safe as possible in vehicles and reduction of child abuse. National pediatric TBI data from 2006 attributed 4% of pediatric TBI to assault; for Indiana in 2007, the proportion was over twice that at 8.29%.

Several limitations were inherent in this study. First, data was only collected from one hospital within Indiana. There are three level I trauma centers and four level II trauma centers in Indiana but only five are currently reporting to the registry due to software programming issues. Other Indiana hospitals are being added to the trauma registry continually. Complete records were available from the selected hospital for only one year, 2007. Both of these limitations resulted in a very small sample size which may not be representative of the larger Hoosier pediatric population. The sample does not include those children who experienced TBI but who were treated in an outpatient setting or not treated at all. Due to data transfer issues with the 2007 dataset, Clarian Riley Hospital trauma registry records in the state trauma registry do not contain Glasgow coma scale or Injury Severity scale scores which would have provided a much more clear approximation of TBI severity than relying on discharge disposition.

As the Indiana trauma registry becomes more complete and the data more reliable it will be a useful tool to investigate various types of trauma. An area of potential interest is determining what risk factors might be responsible for the increased years of potential life lost (29.45 more) caused by unintentional injury for the 1 – 17 year age group for Indiana versus nationwide.

REFERENCES

American Medical Association. (2007, July 10). *2008 ICD-9-CM codes*. Retrieved October 1, 2008 from http://www.amaassn.org/ama1/pub/upload/mm/362/2008icd9missingpage.pdf

Bowman, S.M., Bird, T.M., Aitken, M.E., & Tilford, J.M. (2008). Trends in hospitalization associated with pediatric traumatic brain injuries. *Pediatrics, 122(5)*, 988-993.

Brain Injury Resource Foundation. (2008, September 17). *Children and traumatic brain injury*. Retrieved November 9, 2008 from http://www.birf.info/home/library/pediatrics/ped_chiltrau.html

Day, H., Roesler, J., Gaichas, A. & Kinde, M. 2006. Epidemiology of emergency department-treated traumatic brain injury in Minnesota. *Minnesota Medicine, 89(5)*, 40-4.

Hartman, M., Watson, R.S., Linde-Zwirble, W., Clermont, G., Lave, J http://www.stats.indiana.edu/., Weissfeld, L., Kochanek, P., & Angus, D. (2008). Pediatric traumatic brain injury is inconsistently regionalized in the United States. *Pediatrics, 122,* e712-e180.

Indiana State Department of Health. *2007 Indiana population statistics*. Unpublished.

Indiana Trauma Registry. Retrieved September 24, 2008 from www.indianatrauma.org

Keenan, H.T. & Bratton, S.L. (2006). Epidemiology and outcomes of pediatric traumatic brain injury. *Developmental Neuroscience, 28(4-5)*, 256-63.

Kim, K.A., Wang, M.Y., Griffith, P.M.,. Summers, S., & Levy, M.L. (2000). Analysis of pediatric head injury from falls. *Neurosurgical Focus, 8(1)*, e3.

Leventhal, J. M., Martin, K.D., & Asnes, A.G. (2008). Incidence of fractures attributable to abuse in young hospitalized children: Results from analysis of a United States database. *Pediatrics, 122*, 599-604.

Reid, S.R., Roesler, J.S., Gaichas, A.M., & Tsai, A.K. (2001). The epidemiology of pediatric traumatic brain injury in Minnesota. *Archives of Pediatric & Adolescent Medicine, 155*, 784-789.

Schneier, A.J., Shields, B.J., Hostetler, S.G., Xiang, H., & Smith, G.A. (2006). Incidence of pediatric traumatic brain injury and associated hospital resource utilization in the United States. *Pediatrics, 118*, 483-492.

Stats Indiana. *Regions and metros*. Retrieved November 9, 2008 from http://www.stats.indiana.edu/

Sumich, A.I, Nelson, R., & McDeavitt, J.T. (2007). TBI: A pediatric perspective. In N.D. Zasler, D.I. Katz & R.D. Zafonte (Eds.), *Brain Injury Medicine: Principles and Practice* (pp. 305-313). New York: Demos.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. *TBI data collection*. Retrieved September 24, 2008 from http://www.cdc.gov/ncipc/profiles/tbi/glossary.htm

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. (2008, November 23). *What is traumatic brain injury?* Retrieved November 9, 2008 from http://www.cdc.gov/ncipc/tbi/TBI.htm

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. *WISQARS leading causes of death reports, 1999 – 2005*. Retrived November 9, 2008 from http://webappa.cdc.gov/sasweb/ncipc/leadcaus10.html

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. *WISQARS fatal Injuries: Years of potential life lost reports*. Retrieved November 9, 2008 from http://webappa.cdc.gov/sasweb/ncipc/ypll.html

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Injury Response. (2006, January). *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths*. Retrieved November 9, 2008 from http://www.cdc.gov/ncipc/pub-res/TBI_in_US_04/TBI%20in%20the%20US_Jan_2006.pdf

U.S. Department of Health & Human Services, Centers for Medicare and Medicaid Services. *Diagnosis and Procedure Codes and Their Abbreviated Titles*. Retrieved November 1, 2008 from http://www.cms.hhs.gov/ICD9ProviderDiagnosticCodes/06_codes.asp#TopOfPage

U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. *Healthy people 2010 leading health indicators priorities for action*. Retrieved November 9, 2008 from http://www.healthypeople.gov/LHI/Priorities.htm

Xiang, H. Sinclair, S.A., Yu, S., Smith, G.A., & Kelleher, K. (2007). Case ascertainment in pediatric traumatic brain injury: Challenges using the NEISS. *Brain Injury, 21(3)*, 293-9.