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Paediatric head injuries treated in a children's emergency department from Cluj-Napoca, Romania

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Abstract

The aim of the study was to describe paediatric head injuries and identify factors that led to advanced care. Incident cases of head injuries that sought care from December 2008 to October 2010 at Children's Emergency Hospital Cluj-Napoca were evaluated. The main outcome was transfer or admission to advanced care. From a total of 3053 children treated for an injury, 1541 (50.4%) presented with head injury. A total of 960 (62.3%) of the children with a head injury required advanced care treatment. Young children were more likely to suffer a head injury than older children, but a higher proportion of older children required advanced care (70.3%). Children who suffered a head injury as a consequence of road traffic were almost five times more likely to require advanced care (OR: 4.97; 3.09–8.06) than being released. Our results suggest that data on injuries provide evidence-based information on the nature of injuries children are prone to, and what activity, type, and mechanism of injury impact Romanian children.

Keywords

head injury; children; advanced care; injury database; surveillance

Introduction

Injuries account for approximately one third of all childhood deaths in the European Union (EU), and the number of deaths is far surpassed by the number of non-fatal injuries that require hospital treatment (Baeur & Steiner, 2009). Some of the leading causes of childhood injury deaths include road traffic, falls, drowning, and assault (Adelson & Kochanek, 1988; Bruns & Hauser, 2003; Khambalia et al., 2006; Macnab, 1995; Redmond & Lipp, 2006).

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Many types of external factors contribute to the overall morbidity and mortality from injuries, which range from societal-level factors such as poor safety policies and dangerous environments to interpersonal factors such as the use of safety equipment and risk-taking behaviour such as alcohol use (Sleet, Ballesteros, & Borse, 2010).

Injuries to the head, and in particular the brain, have the highest risk for death and long-term disability of all injury types. Head injuries affect children differently than adults because their brains are in an active phase of development, have a higher fluid content than adults, and injuries can affect critical periods of brain development (Niedzwecki et al., 2008). Traumatic brain injuries may greatly affect children's physical and psychological well-being (McCharty, 2006; Pagulayan, Temkin, Machamer, & Dikmen, 2006; Stancin et al., 2002). In addition to impacting school performance (Taylor et al., 2008), such injuries have an important impact on families (Stancin et al., 2002) and can leave children with life-long disabilities (Bruns & Hauser, 2003; Fay et al., 2009; Horneman, Folkesson, Sintonen, von Wendt, & Emanuelson, 2005). The mechanism, types, and outcomes from paediatric head injury differ by child age, but generally older children have better recovery (Niedzwecki et al., 2008).

Diagnosing the severity of head injury in children can be of particular concern because their symptoms differ from adults and they are often not enough mature verbally to describe how the injury occurred or what they are experiencing. For example, children are less likely than adults to lose consciousness after a head impact, even when the impact involves high-energy transfers (Hymel, Bandak, Partington, & Winston, 1998). Furthermore, children can decompensate from secondary brain injury faster than adults, especially when there is active bleeding in the brain (Pinto, Meoded, Poretti, Tekes, & Huisman, 2012). The timely evaluation and treatment of paediatric brain injuries is thus critical to optimal recovery, and evaluating the severity of paediatric head injuries is a critical task in emergency care. While it is important to ensure that severe cases receive treatment as quickly as possible, it is also important to efficiently use hospital resources. If patients are admitted for care that is not necessary, resources such as hospital costs, diagnostic procedures such as CAT scans, and expensive transfers to trauma hospitals are used inefficiently. Procedures such as CAT scans, when not needed diagnostically, introduce radiation exposure that can be harmful to patients.

Emergency Department clinicians must assess whether or not their paediatric patients require advanced care can be released to their home, weighing the severity of the injury with the resources and potential stress of a hospital admission. Information about the characteristics of head injuries, such as the age, type, and cause, and how these factors are associated with the need for hospital admission can help emergency departments make these decisions. Such information is also a key element in raising awareness about paediatric head injuries. Paediatric and emergency physicians can use this information to advise parents on the risk of injury and preventive measures of childhood trauma (Dinesh, Towner, Vincenten, Segui-Gomez, & Racioppi, 2008; Wanda, 2003).

In Romania, studies have not described head injuries among children, and information about the factors related to hospital admission is not available. To address this gap in knowledge,

this study identified the frequency and characteristics of childhood head injuries with the goal of informing clinicians and prevention efforts. Based on data collected in a large paediatric emergency department in Romania, we described the characteristics, causes, and types of head injuries among children and identified factors associated with the need for hospital admission.

Methods

Study sample and design

Cluj County, Romania, has a population of nearly 700,000 and is one of the fastest growing economies in the country. The Children's Emergency Hospital Cluj-Napoca is the major triage unit for paediatric injuries in the county, and responds to the majority of cases that need emergency care for children aged 0 through 19 in the region. Children aged 0 through 19 who received care for an injury to the head or face region at the Children's Emergency Hospital Cluj-Napoca between 18 December 2008 and 2 October 2010 were included in this study. Data were obtained from the pilot implementation of an injury surveillance system in Romania, the EU Injury Database (IDB). Data were coded using a common coding standard, the IDB Coding Manual (Institute of Consumer Safety, 2005), which includes 18 standard variables, narrative and five extra modules and the IDB data entry software. For this research, the standard variables were used for the analysis. Injury information was collected in accordance with the International Classification of Diseases and Related Health Problems 10th Revision (ICD-10). A total of 3053 injured children received care during the 21 months of the study of which 1541 (50.41%) were diagnosed with an injury to the head.

Data collection process

In 2008, Babes-Bolyai University was funded by the European Commission under PHASE Grant Agreement No. 2006123 to collect data for the European IDB. The Romanian Ministry of Health designated the University as the official National Data Administrator, with responsibilities for overseeing data collection and management. Data for this analysis were accessed as part of this role. The IDB is subject to EU and national regulations on data protection. No individual identifiers were included in the analytical data set.

Data were collected and entered into a database developed for the IDB by trained medical doctors during patient visits at the emergency department. An adult family member or caregiver who accompanied the child to the Emergency Department was asked to provide information for a standardised data collection chart, which included information on the activity, place, and mechanism of injury as well as child's age and gender. Medical staff and caregivers reviewed the medical charts to ensure that information was complete. During the study, all caregivers agreed to provide information. As a result, injury details were collected for all injured patients.

Data measurements

Injury diagnoses and causes of injury were coded using the IDB Coding Manual. Based on the IDB Coding Manual (Institute of Consumer Safety, 2005), head injuries were defined as lesions, fractures, internal damage or other diagnoses to the skull/scalp, brain, face and eye

area. Poisonings were coded as brain injuries due to their neurological effects. The unit of the analysis was the injured individual. The study covariates used for the analysis were sex, age (categorised into four groups: 0–4; 5–9; 10–14; 15–19 years), activity when injured (the type of activity the injured person was engaged in when the injury occurred), place of injury (where the injured person was when the injury event started), mechanism of injury (the process by which the injury occurs) and type of injury sustained to facilitate injury cases to be grouped into diagnosis categories. The type of injury includes the coding no injury diagnosed for cases that were suspicious of injury but no final injury diagnosis was confirmed in the Emergency Department. The outcome variable was treatment status, categorised as Advanced Care or Released. Advanced care patients required treatment beyond the Emergency Department, which included those that were transferred to another hospital ($n = 957$) and those who were admitted to the study hospital ($n = 3$). Since this hospital primarily provides acute care, most patients needing advanced care are transferred. Released patients were children who suffered a head injury but were discharged from the Emergency Department with no need for further care. In this category were included children who were examined and sent home without treatment ($N = 151$) and children who were sent home after treatment ($N = 430$). Children who received no treatment were brought to the hospital to rule out serious injury.

Analysis

Bivariate analyses were conducted to compare outcome status distributions and identify categorical predictors by the covariates. Chi-square tests for independence were used to test statistical significance. Odds of requiring advanced care were calculated for the covariates using a multiple multivariate logistic regression models. Crude odds ratios were calculated to identify the potential for confounding, and a final model included covariates that had a significant odds ratios at the $p = 0.10$ level. Analyses were conducted using SPSS (SPSS Inc., Chicago, Illinois).

Results

Characteristics of head injuries

Among the 3053 patients aged 0 to 19 treated in the Children's Emergency Department, 1541 (50.5%) were treated for a head injury, of which 991 (64.4%) were male and 548 (35.6%) were female (Table 1). Children aged 0–4 comprised 688 (44.6%) of the head injuries, and children aged 10–14 and 15–19 each comprised 246 (16.0%). Overall, 62.3% of children treated for head injuries required advanced care beyond the Emergency Department.

Characteristics of patients treated for head injury

A large majority (92.7%) of head injuries were unintentional (Table 2). Although only 7.3% of head injuries were intentional, children with intentional injuries comprised 8.6% of those who required advanced care ($p = 0.006$). The highest proportion of head injuries occurred in homes (64.4%) followed by streets and highways (14.0%) and institutions (8.6%). Children injured in homes comprised 60.8% of those who required advanced care. Children injured in streets and highways comprised 17.9% of those who required advanced care but only 7.4% of those who did not. The distributions of place of occurrence varied significantly by those

who did and did not require advanced care ($p < 0.001$). The most common mechanisms of head injury were falls (39.9%) and struck by or against an object (33.0%). Road traffic (10.9%) and cutting/piercing (8.0%) injuries were also common. Road traffic head injuries accounted for 15.5% of children that required advanced care and only 4.0% of the ones who were released ($p < 0.0001$). Falls accounted for a higher percentage of children who needed advanced care than among those who didn't require advanced care, while a higher percentage of children injury by being struck by or against an object were released when compared with those who needed advanced care.

Fewer than 2% of children seen in the Emergency Unit had no injury diagnosis, and these comprised less than 1% of the injured children who needed advanced care. These children were most likely transferred to rule out internal head injury. The majority of head injuries were soft tissue (72.2%), of which contusions to the skull was the most common. Nearly all of the fractures and internal brain injuries were referred for advanced care. The distribution for poisoning and consequences of foreign body entering through natural orifice were similar, as primary type of injury, half of each requiring advanced care.

Head injuries outcomes

Compared to young children, children aged 10 through 14 and children aged 15 through 19 were almost twice as likely to be referred for advanced care. Children aged 5 through 10 were 1.27 (OR: 1.27; 95% CI, 0.98–1.66) times as likely to be referred for advanced care compared to children aged 0 through 4 (Table 3).

Children with intentional injuries were more likely to receive advanced care than children with unintentional injuries, but these estimates were not significantly different. Males were more likely to receive advanced care than females but these estimates were not significantly different, as well. Children who suffered a head injury as a consequence of road traffic were nearly five times more likely to require advanced care (OR: 4.97; 95% CI, 3.09–8.06) than being released, followed by children who suffered falls (OR: 1.73; 95% CI, 1.35–2.25). Other mechanisms of injury were not significantly associated with the requirement of advanced care. Children who were injured on the streets and highways were two times more likely to require advanced care (OR: 2.44; 95% CI, 1.69–3.52). In addition, the primary type of injury was associated with the type of treatment received by the patient, suffering from an internal brain injury or a fracture was strongly associated with the likelihood of requiring advanced care.

Discussion

In Eastern Europe in general and in Romania in particular, limited data are available to describe the frequency and causes of injuries in general and on paediatric head injuries in particular (Oprescu, Peek-Asa, Young, Figan, & Nour, 2008). This is the first Romanian study to describe paediatric head injuries and identify factors that led to advanced care of children aged 0 to 19 who had suffered an injury to the head region. A previous retrospective study of childhood injuries had identified that young children were more likely to suffer from an injury than older children (Oprescu et al., 2008); almost half of all injured children

(44.6%) treated by the Cluj-Napoca Children's Emergency Hospital were younger than 4 during the study period.

Among children treated for head injuries, slightly under half were age four or younger. Consistent with previous studies (Oprea et al., 2008) we found that a smaller proportion of younger children required advanced care. This trend suggests that younger children may be brought to the Emergency Department for evaluation for generally less severe injuries than their older counterparts. Diagnosing the severity of head injuries among young children is a challenge because young children are less able to describe what happened, and they experience different symptoms from head impact (for example, they are less likely to lose consciousness) (Hu, Fan, Chang, & Chen, 2013). Thus, Emergency Department evaluation may be needed more frequently for younger children to assess injury severity. Also, parents don't always know when to seek medical care for children with a head injury and may be more vigilant with a younger child. Since parent education is an indicator of childhood non-fatal unintentional injuries, efforts to educate parents about symptoms and appropriate evaluation are needed (Alexandrescu, O'Brien, & Lecky, 2009). Moreover, a better understanding of the knowledge and health care-seeking practices of families could contribute to the development of head injury prevention strategies specific for different age groups (McKinlay et al., 2010). Starting at the age of 10, older children were more likely to require advanced care due to head injuries. As children mature, their interaction with their environments and their physical ability to do increasingly high-risk tasks may raise their risk for head injury as well as its severity.

Head injuries from road traffic crashes were five times more likely to require advanced care than head injuries caused by being struck by or against an object, and far more likely to require advanced care than any other type of injury. Road traffic safety is a concern worldwide; road traffic injuries being the leading cause of death for children of all ages. Studies have shown that head injury is a frequent cause of hospital admissions, road traffic collisions being one of the main mechanisms of injury, accounting for both mild and severe head injuries but being the leading cause of more severe injuries (Bahloul et al., 2011; Mihic, Rotim, Marcikic, & Smiljanic, 2011; Wasserberg, 2002). This indicates the importance of preventive measures for road safety and traffic injuries reduction among children who are at great risk as pedestrians but also as car occupants.

Head injuries are frequent, with certain characteristics among definite groups, which require not only individual emergency medical treatment but also prevention strategies at population level, for children as primary group of intervention, and for parents as secondary target group. From a multidisciplinary point of view, there is a need of a national surveillance system to document injuries in the emergency departments in order to move prevention efforts forward. Information on external causes of injuries is much needed for targeted prevention (Kisser, Latarjet, Bauer, & Rogmans, 2009). Therefore, a routinely data collection of IDB data on a national representative sample is much needed. The 18 standard variables and narrative are important source of information, but the five extra modules can add indicators for the severity of injury, violence prevention, transport and sports injury control, as well as determine the need for support of victims of intentional self-harm. By implementing a full data set collection, emergency departments can become key

stakeholders in providing evidence for hospital resource allocation and public health prevention strategies or programmes. Moreover, a partnership between local administrative authorities, which includes the police departments, emergency departments and ambulance system; public education and research institution and non-governmental organisations may be needed for long-term strategies and actions to reduce the number of paediatric injuries and decrease the societal burden. A joint action of the above-mentioned institutions should lead to the implementation of a common injury surveillance system in Romania.

This study has several limitations. Data collection and data coding error could have been present due to the demands on the staff that could collect and enter the data in the IDB system. However, the study included all patients that had suffered an injury during the study period and sought emergency care at the Cluj-Napoca Children's Emergency Hospital. The extent to which this sample is representative of regional or national paediatric head injuries is unknown because these data are not available. It is possible that this large hospital located in an urban area receives more severe head injuries than smaller, regional hospitals. The admission module of the IDB was not completed because data collectors were not able to track the number of days in hospital for patients who received advance care but were transferred to another hospital ($N = 957$; 99.7%). The IDB does not measure more detailed demographic information or injury severity scores, giving just a simple indication of the treatment and follow-up of the patient; therefore, head injury severity was not calculated or included in the data analysis. Additionally, the information was self-reported, the information being provided by parents or caregivers during the emergency care visit; therefore, information bias could be present.

However, the data collected can provide a better description of paediatric head trauma characteristics and what head injuries are the most likely to require extensive diagnostics and hospital admission. In our patient population, one out of seven children had suffered an internal brain injury, and almost all required advanced care. In addition, children with facial or skull fractures required advanced care in all but one instance. Thus, this data can assist in better preparation and training of the health service personnel in emergency care response, better or different allocation of hospital's human and financial resources, and increase the role of emergency departments in informing parents on risks and risk control, and public health authorities on the need for prevention programmes. In addition to the direct costs, paediatric patients who sustain traumatic brain injury may experience significant behavioural, cognitive and psychosocial sequelae, resulting in reduced speed of information processing, inconsistent attention, inefficient learning of new information, impaired interpersonal interactions and social isolation (Redmond, & Lipp, 2006). Due to differences in head injury between children and adults, paediatric trauma systems have been developed to properly treat paediatric patients and improve treatment outcomes (Gaines, 2005). Furthermore, increasing evidence demonstrates that head injury damage is cumulative in nature, implying that early prevention and intervention is critical (Prins, 2010). In addition to substantial impact on the individual, head injury affects families, communities and the health care system (Alexandrescu et al., 2009; McKinlay et al., 2010). Injury prevention actions usually focus on high-risk population, which from the emergency department data are children older than 10. Community-based interventions (Theurer & Bhavsar, 2013), as well as education of health professionals that first come into contact with head injuries, like

school nurses (Pennington, 2010) are recommended as successful prevention strategies to prevent head injuries in children.

Conclusion

Injuries to the head and brain can lead to severe and disabling trauma. Surveillance data on injuries can provide evidence-based information on the nature of injuries children are prone to, including activity, type and mechanism of injury. Such data can assist in better preparation and training of the health service personnel in emergency care response. Investments in a national surveillance system and interdisciplinary collaborations are critical in this area of practice and research. On-going evaluation should be conducted to create surveillance data systems that are informative yet can be collected without undue burden on hospital and hospital staff. Policies that require data collection and charge an agency with reporting information to hospital from the data system are one approach to a comprehensive data system.

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Table 1

Demographic characteristics.

Demographics	Total	Advanced care <i>N</i> (%)	Released <i>N</i> (%)
Total	1542 (100.0)	960 (62.3)	581 (37.7)
Gender			
Male	991 (64.4)	612 (63.9)	379 (65.2)
Female	548 (35.6)	346 (36.1)	202 (34.8)
Total ^a	1539 (100.0)	958 (100.0)	581 (100.0)
Age			
0–4 years	688 (44.6)	389 (40.5)	299 (51.5)
5–9 years	361 (23.4)	225 (23.4)	136 (23.4)
10–14 years	246 (16.0)	173 (18.0)	73 (12.6)
15–19 years	246 (16.0)	173 (18.0)	73 (12.6)
Total	1541 (100.0)	960 (100.0)	581 (100.0)

Note:

^aGender of child was not specified on two records.

Table 2

Description of the injuries and their causes by treatment.

Variables	Total N (%)	Advanced care N (%)	Released N (%)	Chi-square	p
Intent					
Unintentional	1390(92.7)	863(91.4)	527(95.0)	6.479	0.006
Intentional	109(7.3)	81(8.6)	28(5.0)		
Total	1499(100.0)	944(100.0)	555(100.0)		
Place of occurrence					
Home	985(64.0)	583(60.8)	402(69.3)	37.888	<0.001
Institutions ^a	133(8.6)	71(7.4)	62(10.7)		
Sports and athletics area	48(3.1)	30(3.1)	18(3.1)		
Streets and highways	215(14.0)	172(17.9)	43(7.4)		
Commercial area ^b	78(5.1)	50(5.2)	28(4.8)		
Other place	80(5.2)	53(2.3)	27(1.9)		
Total	1539(100.00)	959(100.0)	580(100.0)		
Mechanism of injury					
Fall	608(39.9)	398(41.9)	210(36.6)	63.597	<0.001
Struck by or against an object	503(33.0)	270(28.4)	233(40.6)		
Road traffic	166(10.9)	143(15.5)	23(4.0)		
Cut or pierce/stab	122(8.0)	68(7.2)	54(9.4)		
Poisoning	98(6.4)	56(5.9)	42(7.3)		
Foreign body	14(0.9)	9(0.9)	5(0.9)		
Suffocation	7(0.5)	3(0.3)	4(0.7)		
Fire/burn	6(0.4)	3(0.3)	3(0.5)		
Total	1524(100.0)	950(100.0)	574(100.0)		
Primary injury					
Soft tissue	1113(72.2)	635(66.1)	478(82.3)	158.787	<0.001
Contusion, bruise	1013	596	417		
Abrasion	46	11	35		
Open wound	45	21	24		
Burns, scalds, corrosions	9	7	2		

Variables	Total N (%)	Advanced care N (%)	Released N (%)	Chi-square	p
Internal Brain Injury	204(13.2)	202(21.0)	2(0.3)		
<i>Concussions</i>	203	201	2		
<i>Other specified brain injury</i>	1	1	0		
Poisoning	87(5.6)	45(4.7)	42(7.2)		
Other and unspecified specified type of injury	80(5.2)	48(5.0)	32(5.5)		
No injury diagnosed	30(1.9)	8(0.8)	22(3.8)		
Fracture	18(1.2)	17(1.8)	1(0.2)		
Consequences of foreign body entering through natural orifice	9(0.6)	5(0.5)	4(0.7)		
Total	1541(100.0)	960(100.0)	581(100.0)		
Part of body injured					
Eye area	65(4.2)	18(1.9)	47(8.1)	139.084	< 0.001
Face, other and unknown	254(16.5)	109(11.4)	145(25.0)		
<i>Ear</i>	35	21	14		
<i>Nose</i>	67	26	41		
<i>Teeth</i>	4	3	1		
<i>Jaw/cheek</i>	9	0	9		
<i>Lip or oral cavity</i>	52	33	19		
<i>Face, other specified</i>	36	10	26		
<i>Face, unspecified</i>	51	16	35		
Brain	295(19.1)	251(26.1)	44(7.6)		
Skull	927(60.2)	582(60.6)	345(59.4)		
Total	1541(100.0)	960(100.0)	581(100.0)		

Notes:

^aIncludes residential institutions, medical service area, school and educational area.^bIncludes industrial or construction area, recreational area commercial area.

Table 3

Patients who received advanced care compared with patients who were released from the Children Emergency Hospital^a.

Variables	Advanced care N%	Release N%	Odds ratio	95% CI	
				Lower	Upper
Age ^b					
0–4 years ^c	389 (56.5)	299 (43.5)	–	–	–
5–9 years	225 (62.3)	136 (37.7)	1.27	0.98	1.66
10–14 years	173 (70.3)	73 (29.7)	1.84	1.34	2.52
15–19 years	173 (70.3)	73 (29.7)	1.82	1.33	2.50
Gender ^d					
Female ^c	346 (63.1)	202 (36.9)	–	–	–
Male	612 (61.8)	379 (38.2)	0.89	0.72	1.11
Intent					
Unintentional ^c	863 (62.0)	527 (38.0)	–	–	–
Intentional	81 (74.3)	28 (25.7)	1.028	0.624	1.694
Mechanism (missing = 17)					
Struck by or against an object ^c	270 (53.7)	233 (46.3)	–	–	–
Cut or pierce/stab	68 (55.7)	54 (44.3)	1.19	0.79	1.78
Fall	398 (65.5)	210 (34.5)	1.73	1.35	2.25
Poisoning	56 (57.1)	42 (42.9)	0.91	0.57	1.43
Road traffic	143 (86.1)	23 (13.9)	4.97	3.09	8.06
Other	15 (55.5)	12 (44.5)	1.18	0.54	2.59
Place					
Home ^c	583 (59.2)	402 (40.8)	–	–	–
Institutions ^e	71 (53.4)	62 (46.6)	0.73	0.50	1.06
Sports and athletics	30 (62.5)	18 (37.5)	0.93	0.50	1.73
Streets and highways	172 (80.0)	43 (20.0)	2.44	1.69	3.52
Commercial areas ^f	50 (64.1)	28 (35.9)	1.19	0.73	1.92
Other place	53 (62.3)	27 (37.7)	1.10	0.66	1.81
Primary injury					

Variables	Advanced care N%	Release N%	Odds ratio	95% CI	
				Lower	Upper
Soft tissue ^{g,c}	635 (57.0)	478 (43.0)	–	–	–
Fracture ^h	17 (94.4)	1 (5.6)	–	–	–
Internal brain injury ^h	202 (99.0)	2 (1.0)	–	–	–
Consequences of foreign body ^h	5 (55.5)	4 (44.5)	–	–	–
Poisoning	45 (51.7)	42 (48.3)	0.68	0.42	1.07
Other and unspecified	48 (60.0)	32 (40.0)	1.14	0.71	1.81
No injury diagnosed	8 (26.7)	22 (73.4)	0.23	0.1	0.56

Notes:

- ^aVariables were controlled for age, constructed as a dichotomous variable, 0–9 years and 10–19 years and gender.
- ^bControlled for gender.
- ^cReference group.
- ^dControlled for age, constructed as a dichotomous variable, 0–9 years and 10–19 years.
- ^eIncludes residential institutions, medical service area, school, educational area.
- ^fIncludes industrial or construction area, recreational area, commercial areas.
- ^gIncludes contusion, bruise; abrasion; open wound; burns, scalds, corrosions.
- ^hCells too small for estimates.