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Pediatrics published online Nov 15, 2010;
DOI: 10.1542/peds.2010-0271

Youth Motorcycle-Related Hospitalizations and Traumatic Brain Injuries in the United States in 2006

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KEY WORDS

hospitalizations, motorcycle, scooters, traffic accidents, nontraffic accidents, adolescents, injury, traumatic brain injury, costs, injury severity

ABBREVIATIONS

E-code—external cause of injury code
HCUP—Healthcare Cost and Utilization Project
ICD-9-CM—*International Classification of Diseases, Ninth Revision, Clinical Modification*
KID—Kids' Inpatient Database
TBI—traumatic brain injury
CI—confidence interval
CDC—Centers for Disease Control and Prevention
ISS—Injury Severity Score

www.pediatrics.org/cgi/doi/10.1542/peds.2010-0271

doi:10.1542/peds.2010-0271

Accepted for publication Aug 31, 2010

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

WHAT'S KNOWN ON THIS SUBJECT: Youth motorcycle traumatic brain injury (TBI) is one of the few areas in which rates of hospitalized TBI among children have been increasing rapidly, and we need a better understanding of the national burden.

WHAT THIS STUDY ADDS: Our findings describe the burden of motorcycle-related injuries and TBIs in both traffic and non-traffic domains and describe the TBI burden on the basis of a very large sample, with the most-precise national estimates ever reported.

abstract

OBJECTIVES: The objectives were to provide national injury and health care cost estimates for youth motorcycle injuries in traffic and non-traffic settings and to focus on the burden of serious motorcycle-related traumatic brain injuries (TBIs) in children and young adults.

METHODS: The 2006 Kids' Inpatient Database is a sample of inpatient discharges for US patients <21 years of age from 38 states. This cross-sectional analysis of the 2006 Kids' Inpatient Database included comparisons of TBI versus non-TBI and traffic versus nontraffic motorcycle-related crashes for ages 12 to 20, with national estimates of hospital charges and costs, length of stay, severity, and long-term disability rates.

RESULTS: Motorcycle-related crashes accounted for 5662 discharges (95% confidence interval: 5201–6122 discharges), which amounts to 3% of injury hospitalizations among youths and 5% of TBI diagnoses; two-thirds of cases were traffic-related, and one-third of patients sustained a TBI (1793 patients [95% confidence interval: 1631–1955 patients]). Among patients with TBIs, the overall probability of long-term disability was 24%. Patients with TBIs were 3.6 times more likely to be discharged to a rehabilitation facility and >10 times more likely to die in the hospital than were patients without TBIs.

CONCLUSIONS: Motorcycle injuries are a substantial cause of youth injury hospitalizations. The large proportion, costs, and morbidity of TBI diagnoses in youth motorcycle crashes emphasize the need for effective crash prevention and head protection. *Pediatrics* 2010;126: 1141–1148

The numbers of motorcycle deaths and injuries are increasing because of increased use of motorcycles for recreation, their appeal as a fuel-saving mode of travel, and repeals of state universal helmet laws.[1] Unfortunately, these trends also hold for young adults and children. The Centers for Disease Control and Prevention (CDC) reported that the motorcyclist death rate for ages 12 to 20 was 0.52 deaths per 100 000 population in 1999 and increased to 0.98 deaths per 100 000 population in 2006, an 88% increase.[2] In a recent review of trends in hospitalized traumatic brain injury (TBI) cases, Bowman et al[3] reported a significant increase in teenage male TBI hospitalization rates from 1998 to 2005 for motorcycle crashes, one of the very few TBI mechanisms that showed an increase over the study period.

The purpose of this article is to describe more fully and to compare the national burden of motorcycle injuries and motorcycle-related TBIs in both traffic and nontraffic domains. This study describes the youth motorcycle burden according to narrow age groups, hospital charges, and long-term outcomes, with data from a nationally representative hospital discharge data set. Such data are useful to prioritize prevention efforts among other forms of child injuries and the different age groups and types of motorcycle riding for the most serious outcomes.

METHODS

Data were obtained from the 2006 Kids' Inpatient Database (KID). The KID is part of the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality. The KID is a nationally representative sample of pediatric hospital discharges drawn from 38 state hospital inpatient databases for children <21 years of age, from 3739 community, nonrehabilitation, nonfederal hospitals. Sampled discharges are applied weights corresponding to their probability of selection, to produce national representation. We report the weighted national estimates, unless otherwise indicated. Analyses were performed by using the survey analysis options in Stata 10.0 (Stata, College Station, TX) and SAS 9.1 (SAS Institute, Cary, NC). Incidence rate calculations used single-year intercensal US population estimates for 2006.[4] This study was categorized as exempt by the University of Pittsburgh institutional review board because it uses a public database without individual identifiers.

The sample contained 3 131 324 unweighted pediatric discharges, representing 7 558 812 national discharges.[5] Cases were first selected for ages 12 to 20. We used this 9-year age range, unlike most studies that examined youths in 5-year age groups up to age 19, because many state motorcycle helmet laws require youths ≤20 years of age to wear a helmet even when persons ≥21 years of age are exempt from helmet requirements. The lower age limit was chosen because of the sharp increase in incidence observed for cases beginning at age 12 and because the cell sizes for <12 years of age often were too small for statistical analysis. There were 1 731 062 all-cause weighted discharges for youths 12 to 20 years of age.

Motorcycle injuries were selected by using *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) external cause of injury codes (E-codes), which in this case identified the mechanism of injury. Motorcycle-related crashes occurring on a public highway were identified by using E-codes E810.2/3 to E819.2/3. Nontraffic motorcycle-related crashes are crashes that occur off the highway and include off-highway crashes resulting from recreational or sporting activities. Nontraffic motorcycle-related crashes were identified with E-codes E820.2/3 to E825.2/3. E-code fourth digits of 2 or 3 denote whether the crash involved a motorcyclist or a motorcycle passenger, respectively. Analyses were performed for the combined population of drivers and passengers, hereafter referred to as riders. Although referring predominately to typical street-registered motorcycles, these ICD-9-CM codes also may refer to motorized bicycles (mopeds), scooters, and minibikes, which may or may not be registered in different states. These codes exclude off-road vehicles that are not usually considered motorcycles. Two cases with ambiguous traffic status were set to missing traffic status, and 1 case with an E820.2 code (indicating a nontraffic accident involving a motor-driven snow vehicle as a motorcyclist) was excluded. The HCUP patient discharge file was merged with the hospital file to determine hospital characteristics for each case. Diagnoses and procedures were grouped by using the clinical classifications software for ICD-9-CM. The clinical classifications software combines individual ICD-9-CM diagnosis and procedure codes into useful broader diagnosis and procedure categories.[6]

TBI was defined and selected on the basis of a TBI-related diagnoses in any of the first 10 diagnosis fields, in accordance with ICD-9-CM codes specified by the CDC TBI surveillance case definition.[7] The CDC TBI case definition includes ICD-9-CM diagnosis codes 800.0 to 801.9, 803.0 to 804.9, and 850.0 to 854.1. Code 959.01 (head injury unspecified), which was added later to the initial CDC case definition, was also included. The TBI codes with late effects and complications (codes 905.0 and 907.0) were excluded. TBI cases also were grouped according to the Barell injury diagnosis matrix.[8] TBI-related, long-term disability rates were estimated by using a validated predictive model developed by Selassie et al[9] on the basis of South Carolina Traumatic Brain Injury Follow-up Registry data. The South Carolina Traumatic Brain Injury Follow-up Registry observed disabilities and their associations with numerous predictors as the basis of this model. The model was applied to TBI cases in our data set for estimation of long-term disability rates. According to this model, disability is defined as having ≥1 of the following: (1) functional limitation in ≥1 activity of daily living, (2) significant postinjury symptoms that limited activities, (3) significant cognitive complaints (ie, scores 2 SDs above the population normative value, ≥22.2), or (4) significant mental health problems (ie, scores 2 SDs below the population normative value, ≤30).[9] In addition, patient comorbidities are included for long-term disability estimates. More-detailed descriptions of the South Carolina Traumatic Brain Injury Follow-up Registry and how it is used can be found in reports by Pickelsimer et al[10] and Selassie et al.[9] Injury severity was calculated by using the algorithms of the injury categorization program provided by the American College of Surgeons, which translates ICD-9-CM diagnosis codes into Abbreviated Injury Scores and Injury Severity Scores (ISSs).[11]

Because our primary aim was to measure the overall burden of motorcycle injuries, in most analyses we included all cases in the database regardless of discharge status, because we wanted to capture the costs of multiple admissions. For incidence and long-term disability estimates, however, patients who were discharged to another short-term care facility were excluded, to minimize duplicate counts attributable to hospital transfers, consistent with the approach of other population-based hospitalization studies.[3] In addition to hospital charges, which represent the billed amounts for services, we also report the approximate hospital costs for providing the services. With these definitions, there were 186 734 injuries with specified mechanisms (all types) among youths 12 to 20 years of age, and 34 779 (18.6%) were TBI related. From these discharges, the motorcycle-related cases were identified and examined.

TABLE 1 Patient Characteristics and Dispositions for Youth Motorcycle-Related Hospitalizations in United States in 2006

Characteristics	*n* (95% CI)	Proportion, % (95% CI)
Total estimated no. of cases	5662 (5201–6122)	
Event location		
Traffic	3839 (3512–4167)	67.8 (65.2–70.4)
Nontraffic	1822 (1735–1909)	32.1 (29.5–34.8)
Gender		
Male	5016 (4609–5424)	89.7 (88.7–90.8)
Female	575 (460–653)	10.3 (9.2–11.3)
Age group		
12–14 y	1023 (887–1159)	18.1 (16.3–19.8)
15–17 y	1797 (1622–1972)	31.7 (30.1–33.4)
18–20 y	2840 (2590–3093)	50.2 (47.9–52.4)
Median income of patient's zip code		
$1–$37 999	1343 (1172–1513)	24.4 (22.0–26.7)
$38 000–$46 999	1313 (1174–1452)	23.8 (22.1–25.5)
$47 000–$61 999	1481 (1336–1627)	26.8 (25.1–28.6)
$62 000 or more	1372 (1199–1546)	24.9 (22.7–27.1)
Disposition of patient		
Routine (home)	4697 (4318–5076)	82.9 (81.4–84.5)
Transfer to short-term hospital	139 (103–175)	2.4 (1.9–3.0)
Transfer to other type of facility	345 (283–407)	6.1 (5.2–6.9)
Home health care	360 (295–425)	6.4 (5.3–7.4)
Discharge against medical advice	27 (15–40)	0.5 (0.3–0.7)
Died	91 (63.5–119.1)	1.6 (1.15–2.1)

RESULTS

The national population estimate for all motorcycle-related hospital discharges for ages 12 to 20 years in 2006 was 5662 (95% confidence interval [CI]: 5201–6122) (Table 1), which represented 3.0% of all hospitalized injuries for this age group. Seven percent (95% CI: 6.3%–7.5%) of motorcycle-related discharges were reported for motorcycle passengers. Male subjects were predominant, representing almost 90% of the discharges. Approximately one-half the cases were in the 18- to 20-year age group (50.2% [95% CI: 47.9%–52.4%]), followed by the 15- to 17-year group (31.7% [95% CI: 30.1%–33.4%]) and the 12- to 14-year group (18.1% [95% CI: 16.3%–19.8%]). Most patients were discharged routinely from the hospital (82.9% [95% CI: 81.4%–84.5%]), but 6.1% (95% CI: 5.2%–6.9%) were transferred to a skilled nursing facility, intermediate care facility, or another type of facility and 1.6% (95% CI: 1.2%–2.1%; 91 [weighted] patients) died in the hospital. The leading principal diagnoses were fracture of the lower limb (29.2% [95% CI: 27.6%–30.8%]), intracranial injury (17.0% [95% CI: 15.7%–18.3%]), crushing injury or internal injury (14.0% [95% CI: 12.8%–15.1%]), and fracture of the upper limb (12.3% [95% CI: 11.1%–13.5%]) (Table 2). Ninety-one spinal cord injuries (95% CI: 67–114 injuries) were reported, accounting for 1.6% (95% CI: 1.2%–2.0%) of diagnoses. Table 3 shows the facility characteristics, procedures, and payer. Only 4.4% (95% CI: 2.9%–5.9%) of the discharges were from a freestanding children's

TABLE 2 Hospital Charges and Length of Stay According to Diagnosis and Hospital Location/Teaching Status for All Youth Motorcycle-Related Discharges in United States in 2006

	n (95% CI)	Proportion, % (95% CI)	Hospital Charges, $			Length of Stay, d	
			Mean	Median	Total	Mean	Median
No. of cases	5662 (5201–6122)		44 227	24 641	248 636 811	4.8	3.0
Top 10 principal diagnoses							
Fracture of lower limb	1654 (1501–1806)	29.2 (27.6–30.8)	42 966	30 392	70 573 921	4.5	3.0
Intracranial injury	962 (848–1076)	17.0 (15.7–18.3)	60 728	24 555	58 148 971	6.6	2.0
Crushing injury or internal injury	791 (695–887)	14.0 (12.8–15.1)	44 397	22 029	34 773 855	5.4	3.0
Fracture of upper limb	697 (607–787)	12.3 (11.1–13.5)	30 068	21 360	20 914 212	2.9	2.0
Other fracture	389 (332–447)	6.9 (6.1–7.7)	46 284	23 906	17 828 648	4.9	3.0
Open wound of extremity	226 (185–268)	4.0 (3.3–4.7)	32 515	18 259	7 255 835	4.4	2.0
Skull/face fracture	187 (149–224)	3.3 (2.7–3.9)	42 490	24 919	7 755 670	3.9	3.0
Other injury or condition	129 (99–159)	2.3 (1.8–2.8)	24 985	16 186	3 199 226	3.0	2.0
Spinal cord injury	91 (67–115)	1.6 (1.2–2.0)	153 209	106 713	13 956 188	14.4	7.0
Open wound of head/neck/trunk	84 (59–109)	1.5 (1.1–1.9)	23 201	14 422	1 947 721	2.9	2.0
Hospital location/teaching status							
Rural			16 440	12 957	6 861 742	2.7	2.7
Urban nonteaching			39 272	22 229	62 575 856	3.9	2.0
Urban teaching			50 004	27 764	172 552 505	5.5	5.5

TABLE 3 Facility Characteristics, Procedures, and Expected Payers for All Youth Motorcycle-Related Hospitalizations in United States in 2006

Characteristics	*n* (95% CI)	Proportion, % (95% CI)
Hospital location/teaching status		
Rural	412 (378–445)	7.5 (6.6–8.3)
Urban nonteaching	1604 (1415–1793)	29.2 (25.8–32.4)
Urban teaching	3480 (3065–3895)	63.3 (59.8–66.9)
Children's hospital status		
Not children's hospital	3494 (3177–3812)	66.1 (60.1–71.9)
Freestanding children's general hospital	233 (152–315)	4.4 (2.9–5.9)
Children's unit in general hospital	1560 (1164–1956)	29.5 (23.5–35.4)
Top 10 principal procedures		
Treatment of fracture/dislocation of lower extremity	800 (721–877)	18.4 (16.9–20.0)
Treatment of fracture/dislocation of hip/femur	743 (650–836)	17.1 (15.8–18.5)
Treatment of fracture/dislocation of radius/ulna	354 (298–409)	8.2 (7.1–9.3)
Debridement of wound	253 (208–297)	5.8 (4.9–6.8)
Other fracture/dislocation procedure	245 (203–287)	5.7 (4.8–6.5)
Suture of skin and subcutaneous tissue	242 (195–289)	5.6 (4.6–6.6)
Respiratory intubation and mechanical ventilation	150 (117–182)	3.4 (2.8–4.1)
Traction, splints, or other wound care	102 (75–130)	2.7 (1.8–2.9)
Skin graft	86 (62.7–110.3)	2.0 (1.5–2.5)
Procedures on spleen	73 (50.5–96.1)	1.7 (1.2–2.2)
Primary expected payer		
Medicaid	958 (828–1087)	17.0 (15.2–18.7)
Private insurance	3669 (3343–3996)	65.0 (62.8–67.2)
Self-pay	636 (549–723)	11.3 (9.9–12.6)
No charge	63 (38–88)	1.1 (0.7–1.5)
Other	314 (255–373)	5.6 (4.6–6.5)

hospital. Private insurance did not cover 35% of the cases.

Two-thirds (67.8% [95% CI: 65.2%–70.4%]) of the discharges were traffic related, with the 18- to 20-year group having the largest proportion of traffic-related discharges (82.1% [95% CI: 74.7%–89.4%]) and the 12- to 14-year group having the smallest (46.7% [95% CI: 39.3%–54.1%]) (data not shown). Traffic-related injuries were more severe, as evidenced by a longer length of stay, higher mean charges and costs, higher mean number of procedures, larger proportion of cases in the ISS severe category, greater likelihood of an intracranial injury diagnosis, and higher inpatient mortality rate (Table 4).

With transfers to short-term stay hospitals excluded, to reduce double counting, the overall incidence rate of motorcycle-related discharges for youths 12 to 20 years of age was 14.5 cases per 100 000 persons (95% CI: 12.1–17.1 cases per 100 000 persons). The overall TBI incidence rate was 4.6 cases per 100 000 persons (95% CI: 3.7–5.5 cases per 100 000 persons); rates increased with age, from 2.2 cases per 100 000 persons (95% CI: 1.5–2.8 cases per 100 000 persons) among 12-year-old youths to 7.1 cases per 100 000 persons (95% CI: 5.9–8.2 cases per 100 000 persons) among 20-year-old youths. The rate of non–traffic-related motorcycle crashes varied little with age, whereas the rate of traffic-related crashes began to increase at age 15, to 5.7 cases per 100 000 persons (95% CI: 4.6–6.7 cases per 100 000 persons), and continued to increase to age 19, to 22.2 cases per 100 000 persons (95% CI: 19.4–25.0 cases per 100 000 persons) (data not shown).

Approximately one-third (31.7% [95% CI: 28.8%–34.5%]) of the discharges involved a TBI diagnosis (Table 5). One-half of the TBI discharges were in the 18- to 20-year age group. Figure 1 pre-

TABLE 4 Characteristics According to Crash Location for All Youth Motorcycle-Related Hospitalizations in United States in 2006

Characteristics	Traffic	Nontraffic
Total, *n* [95% CI] (%)	3839 [3512–4167] (67.8)	1822 [1598–2047] (32.2)
Age, mean, y	17.6	15.9
Age, *n* [95% CI] (%)		
12–14 y	478 [402–553] (12.4)	545 [459–632] (29.9)
15–17 y	1030 [921–1138] (26.8)	767 [664–871] (42.1)
18–20 y	2332 [2123–2541] (60.7)	509 [438–580] (27.9)
Length of stay, mean, d[a]	5.5	3.4
Charges, mean, $[a]	49 721	32 627
Costs, mean, $[a]	18 275	12 373
No. of procedures, mean[a]	2.8	1.9
Gender, *n* [95% CI] (%)[b]		
Male	3366 [3091–3642] (88.6)	1650 [1471–1829] (92.1)
Female	434 [369–468] (11.4)	141 [110–173] (7.9)
ISS, mean[a]	10.5	9.1
ISS, *n* [95% CI] (%)		
0–8	1695 [1563–1826] (44.3)	931 [828–1034] (51.2)
9–16	1354 [1202–1506] (35.4)	685 [587–783] (37.645)
17–75	778 [668–888] (20.3)	203 [158–249] (11.184)
Abbreviated Injury Score for head region		
1–2	748 [669–828] (52.6)	349 [294–404] (63.9)
3	472 [402–542] (33.1)	116 [90–141] (21.1)
4–6	203 [165–240] (14.2)	82 [57–107] (15.0)
Top 5 principal diagnoses, *n* [95% CI] (%)		
Fracture of lower limb	1114 [1000–1228] (29.0)	540 [455–624] (29.6)
Intracranial injury	719 [623–814] (18.7)	243 [196–290] (13.3)
Crushing injury or internal injury	463 [397–529] (12.1)	328 [269–387] (18.0)
Fracture of upper limb	440 [377–503] (11.5)	257 [203–311] (14.1)
Other fracture	255 [211–299] (6.6)	135 [104–166] (7.4)
Disposition, *n* [95% CI] (%)[b]		
Routine (home)	3083 [2825–3341] (80.3)	1614 [1415–1814] (88.6)
Transfer to short-term hospital	96 [69–122] (2.5)	44 [24–63] (2.4)
Transfer to other type of facility	278 [221–336] (7.2)	66 [46–87] (3.6)
Discharge against medical advice	23 [12–35] (0.6)	≤10
Home health care	276 [225–328] (7.2)	84 [53–114] (4.6)
Died in hospital	81 [55–108] (2.1)	≤10
Fatality, *n* [95% CI] (%)[b]		
Nonfatal	3758 [3441–4076] (97.9)	1812 [1589–2036] (99.5)
Fatal	81 [55–108] (2.1)	≤10
Payer, *n* [95% CI] (%)[b]		
Medicare	≤10	≤10
Medicaid	718 [609–827] (18.8)	239 [190–289] (13.2)
Private	2330 [2112 — 2547] (60.9)	1340 [1164–1515] (73.6)
Self-pay	490 [412–567] (12.8)	146 [114–179] (8.0)
No charge	48 [27–69] (1.3)	15 [2–28] (0.8)
Other	236 [188–283] (6.2)	78 [52–105] (4.3)
Hospital location/teaching status, *n* [95% CI] (%)[b]		
Rural	240 [219–260] (6.4)	172 [154–190] (9.8)
Urban, nonteaching	1026 [913–1139] (27.4)	578 [481–674] (32.9)
Urban, teaching	2475 [2185–2764] (66.2)	1005 [834–1176] (57.3)

[a] *t* test, $P < .0001$.
[b] χ^2 test, $P < .0001$.

sents the distribution of TBI discharges according to year of age. The mean length of stay was >2 days longer for TBI discharges (6.3 vs 4.1 days). TBI discharges were more likely to be traffic related (72.4% vs 65.7%). The charges and costs were significantly higher among TBI discharges. Patients with TBIs were 3.6 times more likely to be discharged to another rehabilitation facility and were >10 times more likely to die in the hospital than were patients without TBIs. The probabilities of long-term TBI-related disability among patients with TBIs were 0.24 (95% CI: 0.22–0.26) overall, 0.26 (95% CI: 0.24–0.29) for traffic cases, and 0.17 (95% CI: 0.14–0.21) for nontraffic cases (data not shown).

DISCUSSION

This article highlights the disproportionate burden of TBIs related to youth motorcycle activity in both traffic and nontraffic situations, with the greatest burden being among traffic-related injuries. Concerns about barriers to helmet use to reduce this burden among road users is examined in the companion article.

The overall rate of hospitalized, motorcycle-related injuries among US youths in 2006 was 14.5 cases per 100 000 persons, and the TBI rate was 4.6 cases per 100 000 persons (95% CI: 3.7–5.5 cases per 100 000 persons). Bowman et al[3] reported the rates of motorcycle traffic-related TBIs for 2 different age groups from the HCUP Nationwide Inpatient Sample for 2004 through 2005; rates were reported as 3.0 to 4.2 hospitalizations per 100 000 (95% CI) for ages 15 to 19 years and 0.8 to 1.3 hospitalizations per 100 000 (95% CI) for ages 10 to 14 years. Although those incidence rates were in the same range as our estimates, they were for different periods of time, Bowman et al[3] drew from a smaller sample, and they did not include nontraffic crashes. Coben et al[1] did not report rates, but their national population estimate for traffic and nontraffic cases in the 15- to 19-year age group was 2479 cases (95% CI: 1906–3054 cases), whereas our 15- to 19-year estimate was 2070 cases (95% CI: 1876–2264 cases; not statistically different) (data not shown).

Most studies of motorcycle injury focus on deaths, but doing so ignores the large impact on serious injury and long-term disability among survivors. For example, the CDC reported that

TABLE 5 Characteristics of Motorcycle-Related TBIs for All Youth Motorcycle-Related Hospitalizations in United States in 2006

Characteristics	TBI	Non-TBI
Total, *n* [95% CI] (%)	1793 [1631–1955] (31.7)	3869 [3560–4178] (68.3)
Age, mean, y	17.1	17.0
Age, *n* [95% CI] (%)		
12–14 y	298 [244–352] (16.6)	725 [627–823] (18.7)
15–17 y	583 [509–657] (32.5)	1214 [1088–1340] (31.4)
18–20 y	911 [811–1012] (50.8)	1930 [1759–2100] (49.9)
Length of stay, mean, d[a]	6.3	4.1
Charges, mean, $[a]	58 444	37 642
Costs, mean, $[a]	21 216	14 137
No. of procedures, mean[a]	2.9	2.4
Crash location, *n* [95% CI] (%)[b]		
Traffic	1297 [1143–1451] (72.4)	2542 [,2320–2764] (65.7)
Nontraffic	495 [412–579] (27.6)	1327 [1157–1496] (34.3)
Gender, *n* [95% CI] (%)[c]		
Male	1577 [1405–1749] (88.2)	3439 [3158–3721] (90.4)
Female	210 [168–252] (11.8)	365 [306–423] (9.6)
ISS, mean[a]	14.1	8.2
ISS, *n* [95% CI] (%)		
0–8	454 [392–515] (25.3)	2172 [2005–2339] (56.4)
9–16	694 [615–773] (38.7)	1345 [1193–1497] (34.9)
17–75	645 [561–729] (36.0)	337 [227–396] (8.7)
Abbreviated Injury Score for head region, *n* [95% CI] (%)		
1–2	950 [842–1059] (53.0)	147 [133–162] (83.3)
3	577 [499–654] (32.2)	11 [3–18] (6.0)
4–6	266 [217–314] (14.8)	19 [9–29] (10.7)
Disposition, *n* [95% CI] (%)[b]		
Routine (home)	1355 [1204–1506] (75.6)	3342 [3065–3620] (86.4)
Transfer to short-term hospital	55 [34–76] (3.1)	84 [57–112] (2.2)
Transfer to other type of facility	216 [169–263] (12.1)	129 [99–158] (3.3)
Discharge against medical advice	11 [3–19] (0.6)	11 [7–27] (0.4)
Home health care	79 [53–106] (4.4)	281 [226–335] (7.3)
Died in hospital	75 [50–100] (4.2)	16 [6–25] (0.4)
Fatality, *n* [95% CI] (%)[b]		
Nonfatal	1717 [1529–1906] (95.8)	3853 [3537–4169] (99.6)
Fatal	75 [51–100] (4.2)	16 [6–27] (0.4)
Payer, *n* [95% CI] (%)		
Medicare	≤10	≤10
Medicaid	311 [256–367] (17.4)	646 [554–738] (16.8)
Private	1139 [998–1280] (63.6)	2530 [2304–2757] (65.6)
Self-pay	216 [172–259] (12.0)	421 [356–485] (10.9)
No charge	22 [8–35] (1.2)	41 [22–60] (1.1)
Other	102 [75–129] (5.7)	212 [163–261] (5.5)
Hospital location/teaching status, *n* [95% CI] (%)[b]		
Rural	79 [68–90] (4.6)	332 [305–360] (8.8)
Urban, nonteaching	443 [382–506] (25.7)	1160 [1035–1285] (30.8)
Urban, teaching	1204 [1058–1350] (69.7)	2276 [1996–2556] (60.4)

[a] *t* test, $P < .0001$.
[b] χ^2 test, $P < .0001$.
[c] χ^2 test, $P < .05$.

there were 371 motorcyclist traffic deaths among persons 12 to 20 years of age in 2006.[2] In comparison with the TBI traffic incidence estimates from our study (minus patients who died in the hospital), it can be observed that there were 3663 nonfatal hospitalizations (95% CI: 3367–3958 hospitalizations), among which 1190 (95% CI: 1050–1330) involved TBIs; among those, an estimated 309 patients (95% CI: 273–346 patients) suffered a long-term TBI-related disability.

For all motorcycle injuries (TBI and non-TBI), the CDC database, which excludes in-hospital fatal injuries, reported a national estimate of 6315 transferred/hospitalized traffic and nontraffic "motorcycle" cases between the ages of 12 and 20 for 2006, with a rate of 16.35 cases per 100 000 persons.[12] Our estimate of 14.5 cases per 100 000 was slightly lower than this. This may be explained by some possible incomplete E-coding in the KID data, subtle differences in coding classifications, or sampling and sample variations (the National Electronic Injury Surveillance System all-injury data system is based on reports from only 60 hospitals). However, the findings suggest that the sensitivity of the KID database for motorcycle injuries is reasonable. Overall, the estimates from these data sources are not widely different, which validates the use of the KID, an administrative database, as a good source of motorcycle morbidity data for US youths. The KID data have much less variability than previous hospital discharge-based reports and constitute a much richer data set than other injury surveillance systems with smaller samples. This allows for a better understanding of different injuries, diagnoses, procedures, and health care patterns for narrower age groups and other groupings.

There were several limitations to this study. We used the injury categorization program to assign severity scores, rather than actual Abbreviated Injury Score coding. Because we relied on secondary administrative data, no assessment of the underlying accuracy and completeness with respect to the medical record was possible. Although overall E-coding completeness from the states supplying data to the KID improved to >90% in 2006 (Agency for Healthcare Research and Quality, personal written communication, 2009), some underassessment of motorcycle injuries was possible. It is important to note the lack of detail regarding the vehicle type inherent in ICD-9-CM e-codes, because these codes also include motorized bicycles (mo-

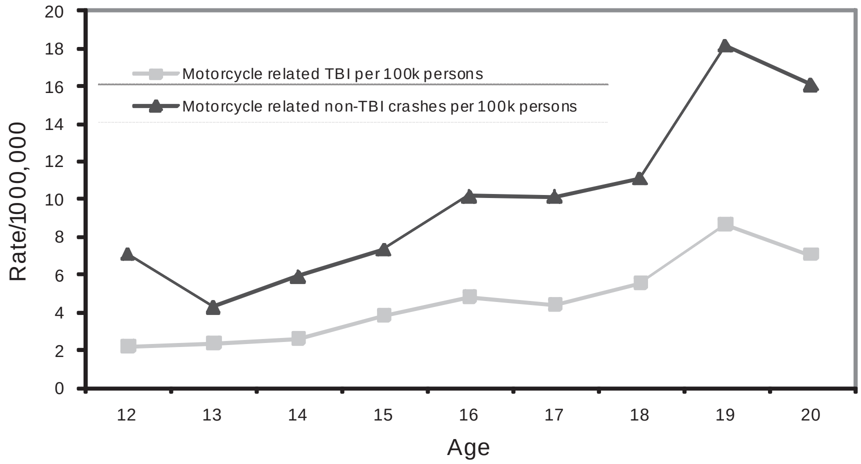

FIGURE 1
Motorcycle injury discharge incidence rates according to TBI status and age in the United States in 2006. Rates (cases per 100 000 persons) exclude patients who were discharged to a short-term care facility.

peds), scooters, and minibikes, which may or may not be registered. It is also possible that we underestimated TBI rates, because Shore et al[13] showed some underreporting, especially of mild TBIs, in hospital discharge data. As in other hospital discharge data–based studies, we could not detect patients who died before hospitalization or were not admitted as inpatients. Another limitation is that no data on patient helmet use were available from the hospital discharge data. Lastly, we had no data on any exposure indices for the youths in this study, and exposure-based risk (eg, ownership levels, registration rates, licensing rates, numbers of trips, hours of riding, or miles traveled), an important factor in assessment of personal risk, could not be considered. The lack of exposure data may lead to underestimations of the true risk for the younger age groups, because younger youths generally do not own or spend as much time or travel distance on motorcycles, compared with their older counterparts.

CONCLUSIONS

As the number of youth motorcycle crashes increases, so does the burden of the related deaths and serious injuries on the victims, families, and society. Effective prevention efforts to reduce the risk of crashes and injuries among youths, as for adult riders, are needed. TBIs, whether they occur in traffic or nontraffic settings, are of particular concern, because of their long-term effects and high mortality risks.

ACKNOWLEDGMENTS

This work was performed under a cooperative agreement with the National Highway Traffic Safety Administration (grant DTNH22-04-H-05087).

We acknowledge assistance in calculating long-term TBI disability from Dr Eduard Zaloshnja (Pacific Institute for Research and Evaluation) and Dr Anbesaw Selassie (Medical University of South Carolina). We also acknowledge the key role of the state data organizations whose HCUP participation made this study possible. These state data organizations include the Arkansas Department of Health and Human Services, Arizona Department of Health Services, California Office of Statewide Health Planning and Development, Colorado Hospital Association, Connecticut Hospital Association, Florida Center for Health Information and Policy Analysis, Georgia Hospital Association, Hawaii Health Information Corp, Illinois Department of Public Health, Indiana Hospital Association, Iowa Hospital Association, Kansas Hospital Association, Kentucky Cabinet for Health and Family Services, Maine Health Data Organization, Maryland Health Services Cost Review Commission, Massachusetts Division of Health Care Finance and Policy, Michigan Health and Hospital Association, Minnesota Hospital Association, Hospital Industry Data Institute, Nebraska Hospital Association, Nevada Center for Health Information Analysis, University of Nevada, New Hampshire Department of Health and Human Services, New Jersey Department of Health and Senior Services, New York State Department of Health, North Carolina Cecil G. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill, Ohio Hospital Association, Oklahoma State Department of Health, Oregon Association of Hospitals and Health Systems, Rhode Island Department of Health, South Carolina State Budget and Control Board, South Dakota Association of Healthcare Organizations, Tennessee Hospital Association, Texas Department of State Health Services, Utah Department of Health, Vermont Association of Hospitals and Health Systems, Virginia Health Information, Washington State Department of Health, West Virginia Health Care Authority, Wisconsin Department of Health and Family Services, and Wyoming Hospital Association. We also thank Dr David Clark for developing and sharing the injury categorization software used for assigning injury severity.

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The Rise of the Carnation: *Say you want to pick up some flowers for your partner to commemorate a special occasion or just to say, "Hey, you are special." Would you buy carnations? Probably not. And you would not be alone. Carnations,* dianthus caryophyllus, *have not been popular of late except in grocery and corner stores selling inexpensive flowers. Carnations have not always been so scorned. Described in ancient Greece, given a Latin name that means divine flower, carnations were a favorite flower during the Renaissance. Depictions of carnations appeared in works by Shakespeare, paintings by Da Vinci, pottery decorations, and prized tapestries. By the beginning of the 18th century, the carnation disappeared from the artistic and social scene. Carnations, however, may be making a comeback. As reported in* The Wall Street Journal *(Teague L, October 23, 2010), the carnation has re-emerged as a flower of choice among a few of the very fashionable appearing singly worn on a sweater or jacket, combined with thousands to decorate a wedding, or as a floral motif for designers. Most carnations are grown in Columbia and come in a wide range of striking and rich colors. Those found in florist shops tend to have larger and showier heads than their grocery store relatives and even a rich scent of clove (who knew?). While the rose is not about to lose its place to the carnation, the increased interest in the flower is welcome news for carnation aficionados. And for those of you who buy carnations, Martha Stewart recommends a teaspoon of bleach in water to prolong the already impressive longevity of the flower.*

Noted by WVR, MD

Youth Motorcycle-Related Hospitalizations and Traumatic Brain Injuries in the United States in 2006

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Pediatrics published online Nov 15, 2010;
DOI: 10.1542/peds.2010-0271