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Fractures and Traumatic Brain Injuries: Abuse Versus Accidents in a US Database of Hospitalized Children

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Fractures and Traumatic Brain Injuries: Abuse Versus Accidents in a US Database of Hospitalized Children

WHAT'S KNOWN ON THIS SUBJECT: Studies of serious abusive injuries in young children have focused on TBIs or fractures. No study has examined these 2 injury types simultaneously and compared abuse versus accidents.

WHAT THIS STUDY ADDS: This study shows considerable overlap in TBIs and fractures attributable to abuse. Among children <12 months of age, TBIs and/or fractures occurred in 1 of 2000. Falls occurred more commonly than abuse, even among very young children.

abstract

OBJECTIVE: The goal was to use a national database to determine the incidence of abusive traumatic brain injuries (TBIs) and/or fractures and the frequency of abuse versus accidents among children <36 months of age.

METHODS: We used the 2006 Kids' Inpatient Database and classified cases into 3 types of injuries, that is, (1) TBI only, (2) TBI and fracture, or (3) fracture only. Groups 2 and 3 were divided into 3 patterns, that is, (1) skull fractures, (2) skull and nonskull fractures, or (3) nonskull fractures. For each type and pattern, we compared abuse, accidental falls, other accidents, and motor vehicle accidents.

RESULTS: The incidence of TBIs and/or fractures attributable to abuse was 21.9 cases per 100 000 children <36 months of age and 50.0 cases per 100 000 children <12 months of age. In the abuse group, 29.9% of children had TBIs only, 28.3% TBIs and fractures, and 41.8% fractures only. Abused children were younger and were more likely to be enrolled in Medicaid. For TBI only, falls were more common than abuse in the first 2 months of life but abuse was more common from 2 to 7 months. For TBI and skull fracture, falls were more common during the first year of life. For skull fracture only, almost all injuries were attributable to falls.

CONCLUSIONS: There was overlap in TBIs and fractures attributable to abuse. Among <12-month-old children, TBIs and/or fractures attributable to abuse occurred in 1 of 2000. Falls occurred more commonly than abuse, even among very young children. *Pediatrics* 2010;126: e104–e115

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KEY WORDS
accidents, injury, maltreatment

ABBREVIATIONS
KID—Kids' Inpatient Database
MVA—motor vehicle accident
TBI—traumatic brain injury
ICD-9-CM—International Classification of Diseases, Ninth Revision, Clinical Modification
CI—confidence interval
E-code—external cause-of-injury code

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Traumatic brain injuries (TBIs) and fractures are the most-common, serious injuries attributable to child abuse among young children. Previous studies focused on one or the other of these types of injuries, as if they were separate types, but clinical overlap occurs often. For example, in one series of 39 patients with subdural hematomas attributable to abuse, either rib or long-bone fractures were identified for 51% of patients.[1]

Most studies of TBIs or fractures attributable to abuse focused on the clinical characteristics of the children[1,2] or the characteristics that distinguished accidental from abusive injuries.[3,4] A few studies used case surveillance to examine the incidence of either abusive TBIs or abusive fractures,[5,6] and we used national US databases to estimate the incidence of each of these types of injuries.[7,8] In addition, epidemiological studies used hospital data from California to examine injuries, including accidental falls and abuse.[9,10] Those studies, however, examined all types of injuries in hospitalized children.

No previous study used a sufficiently large database to examine both TBIs and fractures and to compare the characteristics of injuries attributable to abuse versus accidents during the first 3 years of life. This type of epidemiological information would be helpful to clinicians when they evaluate such injuries in young children. For example, knowledge of the age distribution of such injuries could provide information about the likelihood of these occurrences. Therefore, in this study we used a large US database of hospitalizations in 2006 to examine data for young children with TBIs and/or fractures. We compared the demographic characteristics of children with injuries attributable to abuse versus accidents and examined the age distributions of abuse and accidents among children with 3 types of injuries, that is, (1) TBI only, (2) TBI and ≥1 fracture, and (3) fractures only. In addition, we examined clinically relevant patterns of injuries. Among children with TBIs and fractures, we examined 3 patterns, that is, (1) TBI and skull fracture, (2) TBI and skull and nonskull fractures, and (3) TBI and nonskull fractures; among children with fractures only, we examined the same 3 patterns, that is, (1) skull fracture, (2) skull and nonskull fractures, and (3) nonskull fractures.

METHODS

We used the 2006 Kids' Inpatient Database (KID),[11] which includes an 80% sample of all acute-care hospitalizations from 3739 hospitals in 38 states; these states include >88% of the US population. Every 3 years since 1997, a KID data set has been made available by the Healthcare Cost and Utilization Project, sponsored by the Agency for Healthcare Research and Quality. The database contains information about demographic features, payment, and hospitals, 15 fields for International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), diagnosis codes,[12] and 4 fields for external cause-of-injury codes (E-codes),[12] which provide information about the causes of injuries.

We confined our analyses to children who were <36 months of age, because most serious injuries attributable to abuse occur among young children. Analyses were conducted by using 3 age demarcations, that is, <12 months, 12 to 23 months, and 24 to 35 months of age. TBI was defined by using ICD-9-CM codes for brain injury; children were not included in this group if the only injury involving the head was a skull fracture. This definition of TBI is similar to that used by Keenan et al[5] in the only prospective, case-surveillance study of inflicted TBIs in the United States and is identical to that used by Ellingson et al[7] in their KID study of the incidence of inflicted TBIs. We used 5 major groups of ICD-9-CM codes, that is, (1) skull fracture and intracranial injury (codes 800.1–800.4, 800.6–800.9, 801.1–801.4, 801.6–801.9, 803.1–803.4, 803.6–803.9, 804.1–804.4, and 804.6–804.9), (2) concussion (codes 850.0–850.9), (3) cerebral laceration and contusion (codes 851.0–851.9), (4) subdural hemorrhage after injury (codes 852.2 and 852.3), and (5) other intracranial injury (codes 852.0, 852.1, 852.4, 852.5, 853.0–853.1, and 854.0–854.1). Fractures were defined by using the ICD-9-CM codes for fractures (codes 800–829).

Child abuse was defined by using an ICD-9-CM code for abuse (code 995.5) or an E-code for assault (codes E960–E969). Cases whose only abuse definitions were for emotional or psychological abuse (code 995.51), nutritional neglect (code 995.52), or sexual abuse (code 995.53) were not counted as abuse. Accidental injuries included 3 main groups, that is, (1) accidental falls (codes E880–E888), (2) other accidents (eg, struck by a falling object or against an object or person) (codes E916–E928), and (3) motor vehicle accidents (MVAs) and related accidents (codes E810–E829). The remaining cases with injuries were classified in the following groups: (1) cases with no E-codes, (2) cases with a fracture with unspecified cause (code E887), (3) cases in which it was not determined whether the injury was accidental or intentional (codes E980–E989), and (4) cases in which the coding indicated a birth injury (code 767) or an underlying medical condition, such as osteogenesis imperfecta (code 756.51) or rickets (code 268.0).

We grouped cases into 3 types of injuries, that is, (1) TBI only, (2) TBI with fracture, or (3) fracture only. Within

each type of injury, we used the weightings provided with the KID to calculate the proportions of children in the United States with abuse, accidental falls, other accidents, and MVAs. In addition, within each type of injury, we compared the demographic characteristics within the 4 different causes of injury. Weighted proportions were compared by using χ^2 tests, and means were compared by using analysis of variance. Weighting took into account 6 characteristics of the hospitals, namely, ownership (control), bed size, teaching status, type of hospital (eg, freestanding children's hospital), rural/urban location, and region of the country.

For calculation of the incidence of TBIs and/or fractures attributable to abuse, the numerator was the weighted number of children with the specific type of injury attributable to abuse; the weighting corrected the numerator for the sampling methods of the KID, so that the numerator could provide a national estimate.[11] The denominator was based on estimates of the national population of the specific age for 2006. Census data were obtained from the 2006 intercensal estimates.[13] Confidence intervals (95% CIs) were calculated by using the Taylor series in SAS 9.1.3 (SAS Institute, Cary, NC).

For each type of injury, we examined the weighted frequency of accidental falls, other accidents, and abuse at 1-month intervals during the first 36 months. For these analyses, we excluded MVAs because such injuries are unlikely to be confused with abuse. Finally, we examined the frequency of accidents and abuse among children with specific patterns of injuries. For children with TBI and fractures, we examined (1) TBI with skull fracture, (2) TBI with skull and nonskull fractures, and (3) TBI with nonskull fractures. For children with fractures, we examined the same 3 patterns, (1) skull fracture only, (2) skull and nonskull fractures, and (3) nonskull fractures only.

In some cases, data on the age in months were not available but data on the age in years were provided. These cases were included in the analyses with stratification according to age groups but not in the calculations of mean ages or in the figures showing frequencies for each month of life. This study was considered exempt from review by the institutional review board of Yale University School of Medicine.

TABLE 1 Proportions of Children With Each Type of Injury in Each Age Group

Type of Injury	Proportion, %			
	0–11 mo (N = 8335)	12–23 mo (N = 3417)	24–35 mo (N = 7070)	Total (N = 18 822)[a]
TBI	21.5	21.3	14.1	18.7
TBI and fracture	27.5	14.7	11.8	19.3
Fracture	51.0	64.0	74.2	62.1
Total	100.0	100.0	100.1	100.1

[a] Includes all children <36 months of age with TBIs and/or fractures.

RESULTS

TBI and/or Fractures

In the weighted sample, there were 18 822 children who were <36 months of age and had TBIs and/or fractures. Of those children, 3512 (18.7%) had TBIs, 3630 (19.3%) had TBIs and fractures, and 11 680 (62.1%) had fractures only. The overall incidence of TBI and/or fracture was 152.5 cases per 100 000 children <36 months of age (95% CI: 137.4–167.6 cases per 100 000 children). The incidence was highest among children <12 months of age (201.8 cases per 100 000 children [95% CI: 181.2–222.4 cases per 100 000 children]), compared with those 12 to 23 months of age (83.2 cases per 100 000 children [95% CI: 74.4–91.9 cases per 100 000 children]) and those 24 to 35 months of age (172.3 cases per 100 000 children [95% CI: 146.4–198.2 cases per 100 000 children]).

Table 1 shows the proportions of all children with the 3 types of injuries in each age group. There was a statistically significant association (P < .0001) between age and type of injury. TBI alone was noted for approximately one-fifth of the children in the 2 younger age groups (0–11 months, 21.5%; 12–23 months, 21.3%). Children with TBI and fractures represented 27.5% of children 0 to 11 months of age, and this value decreased to 11.8% in the oldest group. The proportion of children with fractures increased from 51% among children <12 months of age to 74.2% in the oldest age group.

TBI and/or Fractures Attributable to Abuse

The incidence of TBI and/or fractures attributable to abuse for children <36 months of age was 21.9 cases per 100 000 children (Table 2). The incidence was highest in the youngest age group (50.0 cases per 100 000 children [95% CI: 42.6–57.4 cases per 100 000 children]) and was substantially lower in the 2 older age groups (12–23 months, 9.2 cases per 100 000 children [95% CI: 7.4–11.1 cases per 100 000 children]); 24–35 months, 6.3 cases per 100 000 children [95% CI: 4.4–8.2 cases per 100 000 children]).

Table 3 shows that there was a statistically significant association (P < .0001) between the causes of injuries and the 3 types of injuries. Children with abuse represented 14.4% (n = 2703) of the overall sample and even larger proportions of children with TBI only (23.0% [n = 807]) and children

TABLE 2 Incidence of Abuse Among Children With TBIs and/or Fractures

Age	Total in Group	No. of Cases Attributable to Abuse	Incidence Estimate (95% CI), Cases Per 100 000 Children in Age Group
0–11 mo	8335	2066	50.0 (42.6–57.4)
12–23 mo	3417	378	9.2 (7.4–11.1)
24–35 mo	7070	258	6.3 (4.4–8.2)
Total	18 822	2703	21.9 (18.7–25.1)

TABLE 3 Causes of Injuries for Children With TBIs and/or Fractures

Cause of Injury	Proportion, %			
	TBI Only ($N = 3512$)	TBI and Fracture ($N = 3630$)	Fracture Only ($N = 11\,680$)	Total ($N = 18\,822$)
Accidental fall	44.4	43.5	50.0	47.7
Abuse	23.0	21.1	9.7	14.4
MVA	12.1	15.4	8.8	10.7
Other accident	7.8	7.2	12.2	10.4
Other[a]	12.7	12.8	19.3	16.8
Total	100.0	100.0	100.0	100.0

$P < .0001$.

[a] Other includes cases with no E-code, an E-code for fracture with unspecified cause, or an E-code indicating that it was undetermined whether the injury was accidental or intentional. In addition, <1% of cases included in the other group were attributable to medical conditions or birth trauma.

with TBI and fractures (21.1% [$n = 766$]). In contrast, 9.7% ($n = 1130$) of children with fractures only had been abused. Of all abused children in the sample, 29.9% had TBI only, 41.8% had fractures only, and 28.3% had both types of injuries.

Table 4 shows the proportion of abuse cases within each age group for each type of injury. Overall, 24.8% of children 0 to 11 months of age with TBI and/or fractures had been abused, and this value decreased to 11.1% and 3.7% for the 12– to 23-month and 24- to 35-month age groups, respectively ($P < .0001$). Within each age group, there was a statistically significant association between the proportion of abuse and the type of injury ($P < .0001$). In each age group, the proportion of children with abuse was highest among children with TBI only and lowest among children with fractures only. For example, among children 0 to 11 months of age, 32.6% of those with TBI only, 26.8% of those with TBI and fractures, and 20.4% of those with fractures only were abused.

The overall sample had a mean age of 14.0 months, and 59.3% of subjects were male. The racial/ethnic composition of the sample was 35.1% white, 11.6% black, 20.7% Hispanic, 7.6% other, and 25.0% unknown; 58.1% of subjects were enrolled in Medicaid or had no insurance, 36.9% had private insurance or were in a health maintenance organization, and 4.8% had other types of insurance. There were statistically significant differences for all 4 of these demographic variables when the data were analyzed according to the specific cause of injury (abuse, accidental fall, other accident, or MVA) within each type of injury (data not shown). These differences were most marked for the child's mean age and health insurance (Table 5). For all 3 types of injuries, children with abuse, compared with other causes, had the youngest mean age. For example, among children with TBI only, those with abuse had a mean age of 8.1 months, compared with 13.8 months for accidental falls, 13.6 months for other accidents, and 17.2 months for MVAs. There also were marked differences in the children's medical insurance according to the cause of injury. The proportion of children enrolled in Medicaid or without insurance was largest among abused children for all 3 types of injuries (74.5%–80.7%).

TABLE 4 Proportions of Children With Injuries Attributable to Abuse

Age	Proportion, % (n/N)			
	TBI Only	TBI and Fracture	Fracture Only	All
0–11 mo	32.6 (583/1791)	26.8 (615/2295)	20.4 (868/4248)	24.8 (2066/8335)
12–23 mo	19.0 (138/726)	17.1 (86/502)	7.1 (155/2188)	11.1 (378/3417)
24–35 mo	8.6 (86/994)	7.8 (65/832)	2.1 (108/5244)	3.7 (258/7070)
Total	23.0 (807/3512)	21.1 (766/3630)	9.7 (1130/11 680)	14.4 (2703/18 822)

Patterns of Injuries

Figures 1 to 3 show the weighted numbers of cases of abuse, accidental falls, and other accidents at each month of age for each type of injury. The proportions of cases in which data on the age in months were available are noted. As shown in Fig 1, TBIs attributable to accidental falls occurred more commonly than did TBIs resulting from abuse or other accidents among children <2 months of age. In contrast, from 2 months to 7 months, abuse was the most common cause of TBIs.

Figure 2A shows the frequencies of cases of TBIs and fractures; accidental falls and abuse were very common during the first 5 months of life. When specific clinical patterns were examined, accidental falls resulting in TBIs and skull fractures were more common than abuse from 0 to 35 months, and this was especially striking among children <12 months of age (Fig 2B). In contrast, for children with TBIs and nonskull fractures (Fig 2C) or with TBIs and skull and nonskull fractures (Fig

TABLE 5 Age and Insurance Status of Children With TBI Only, TBI and Fracture, or Fracture Only

	Abuse	Accidental Fall	Other Accident	MVA	*P*
TBI only ($N = 3068$)					
n	807	1561	276	425	
Age, mean ± SD, mo	8.1 ± 0.40	13.8 ± 0.41	13.6 ± 1.01	17.2 ± 0.98	<.0001
Insurance, %					
Medicaid/self-pay	74.5	50.7	54.7	53.6	<.0001
Private/HMO	19.0	44.3	40.0	41.0	
Other	6.5	5.0	5.4	5.3	
TBI and fracture ($N = 3165$)					
n	766	1579	260	560	
Age, mean ± SD, mo	6.3 ± 0.41	10.1 ± 0.40	13.6 ± 1.27	16.9 ± 0.65	<.0001
Insurance, %					
Medicaid/self-pay	77.0	49.8	59.7	58.3	<.0001
Private/HMO	17.2	46.1	32.5	37.0	
Other	5.8	4.1	7.8	4.7	
Fracture only ($N = 9424$)					
n	1130	5844	1421	1029	
Age, mean ± SD, mo	7.5 ± 0.31	17.6 ± 0.29	17.2 ± 0.48	21.9 ± 0.49	<.0001
Insurance, %					
Medicaid/self-pay	80.7	51.8	60.1	56.6	<.0001
Private/HMO	15.7	44.0	34.9	38.4	
Other	3.7	4.2	5.0	5.0	

Age data were missing for 28% of the TBI group, 27% of the TBI and fracture group, and 37% of the fracture group. Insurance comparisons excluded 20 cases with unknown insurance status. HMO indicates health maintenance organization.

2D), almost all of the injuries during the first 12 months of life were attributable to abuse.

For children with fractures, numbers of both accidental falls and abusive injuries peaked during the first months of life, and accidental falls were more common after 4 months of age (Fig 3A). When the clinical patterns were examined, almost all cases of skull fractures only were attributable to accidental falls, particularly during the first 12 months of life (Fig 3B). In contrast, for children <6 months of age with nonskull fractures, the most common cause was abuse; as children became more mobile, the frequency of accidental falls increased (Fig 3C). There were fewer children with skull and nonskull fractures but, during the first 12 months of life, most of these cases were attributable to abuse (Fig 3D).

DISCUSSION

By using a national database of data on hospitalized children, we found a relatively high incidence of cases of TBI and/or fracture attributable to abuse, substantial differences in the age and

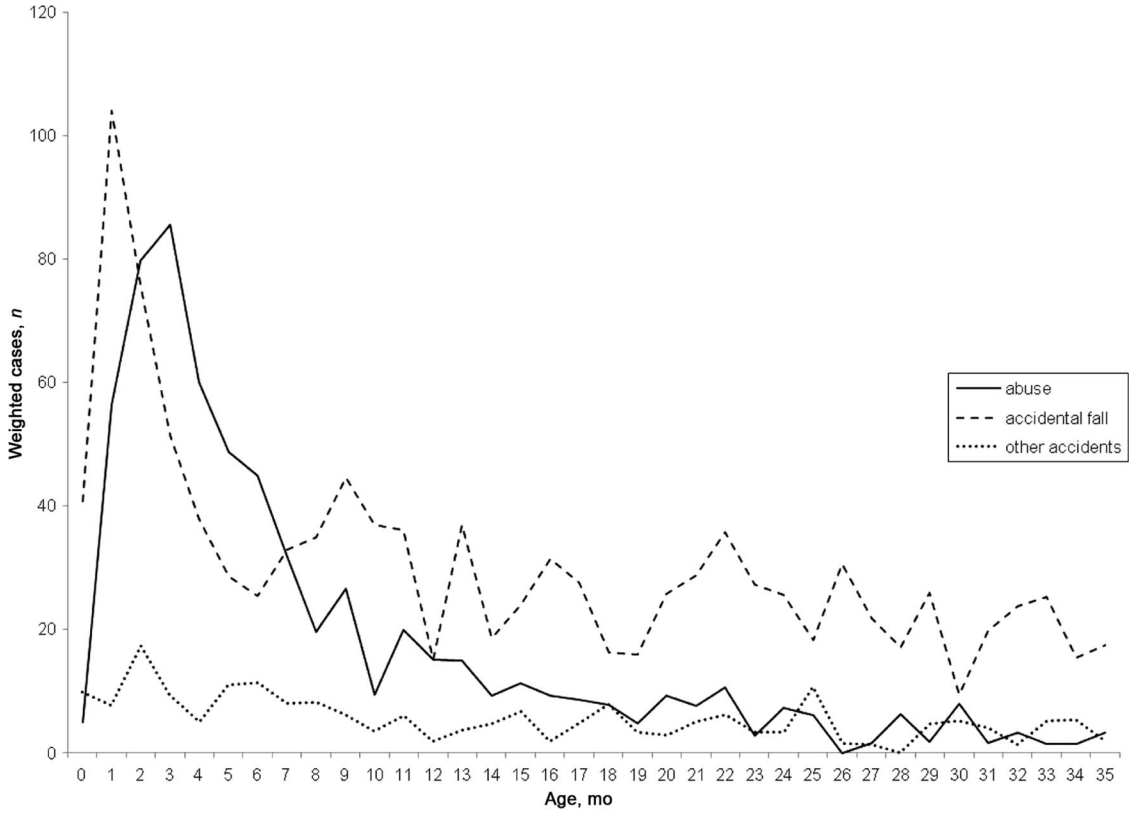


FIGURE 1
Causes of TBIs only. Age data were available for 73.6% of eligible (weighted) cases (1944 of 2643 cases).

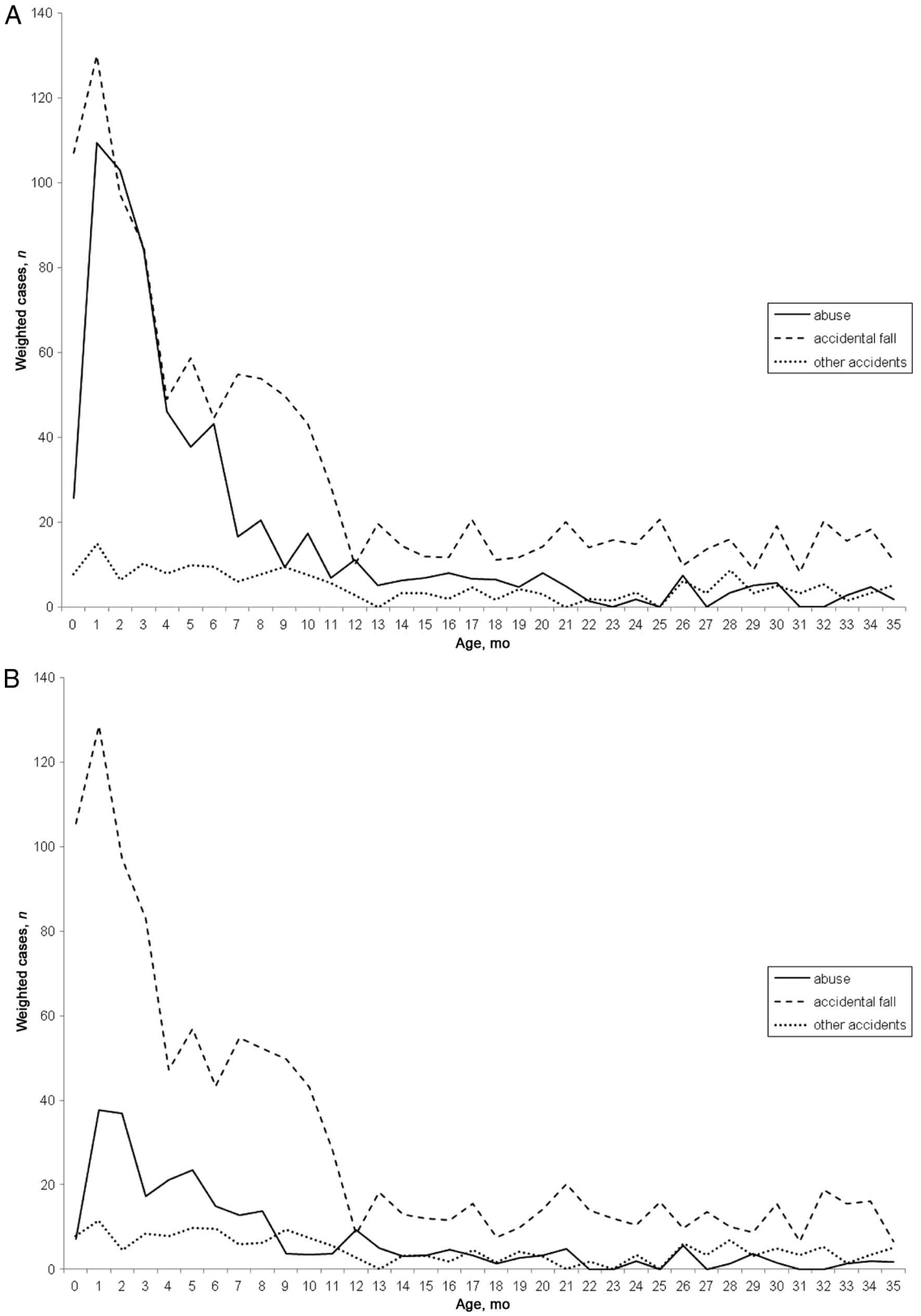
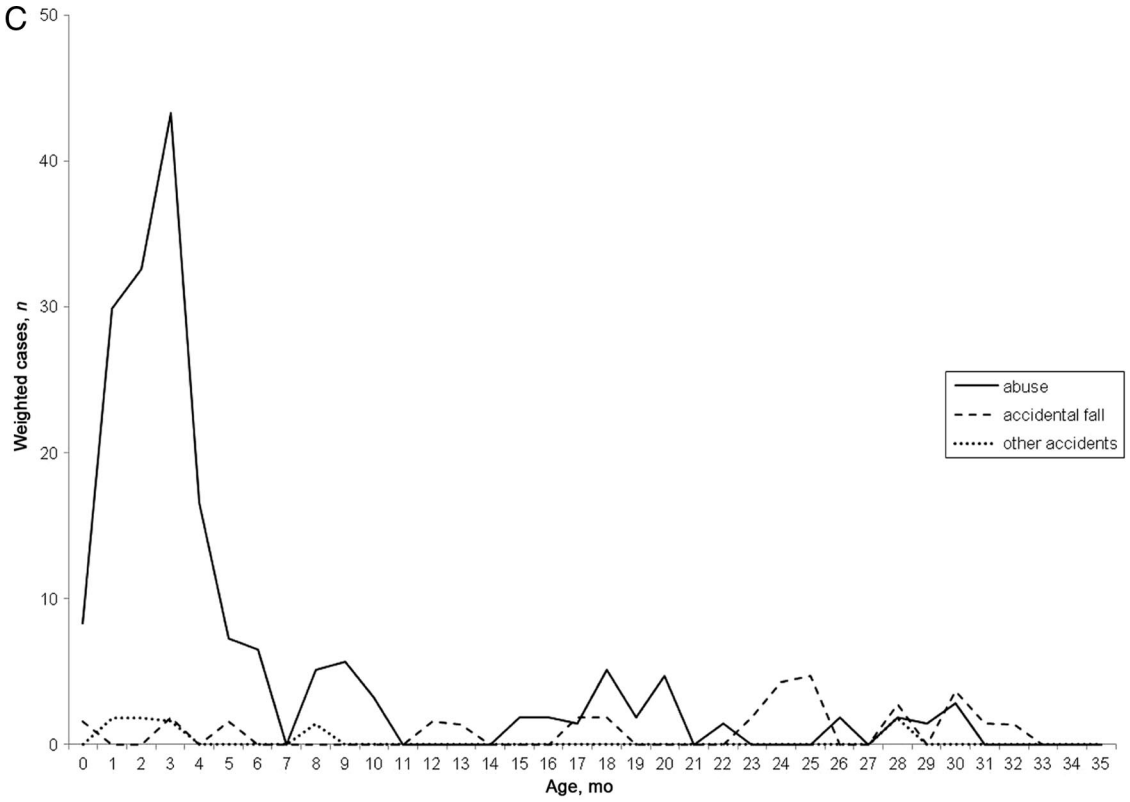


FIGURE 2

A, Causes of TBIs and fractures. Age data were available for 74.9% of eligible (weighted) cases (1952 of 2605 cases). B, Causes of TBIs and skull fractures. Age data were available for 73.1% of eligible (weighted) cases (1517 of 2075 cases). C, Causes of TBIs and nonskull fractures. Age data were available for 83.0% of eligible (weighted) cases (225 of 271 cases). D, Causes of TBIs and skull and nonskull fractures. Age data were available for 81.1% of eligible (weighted) cases (210 of 259 cases).



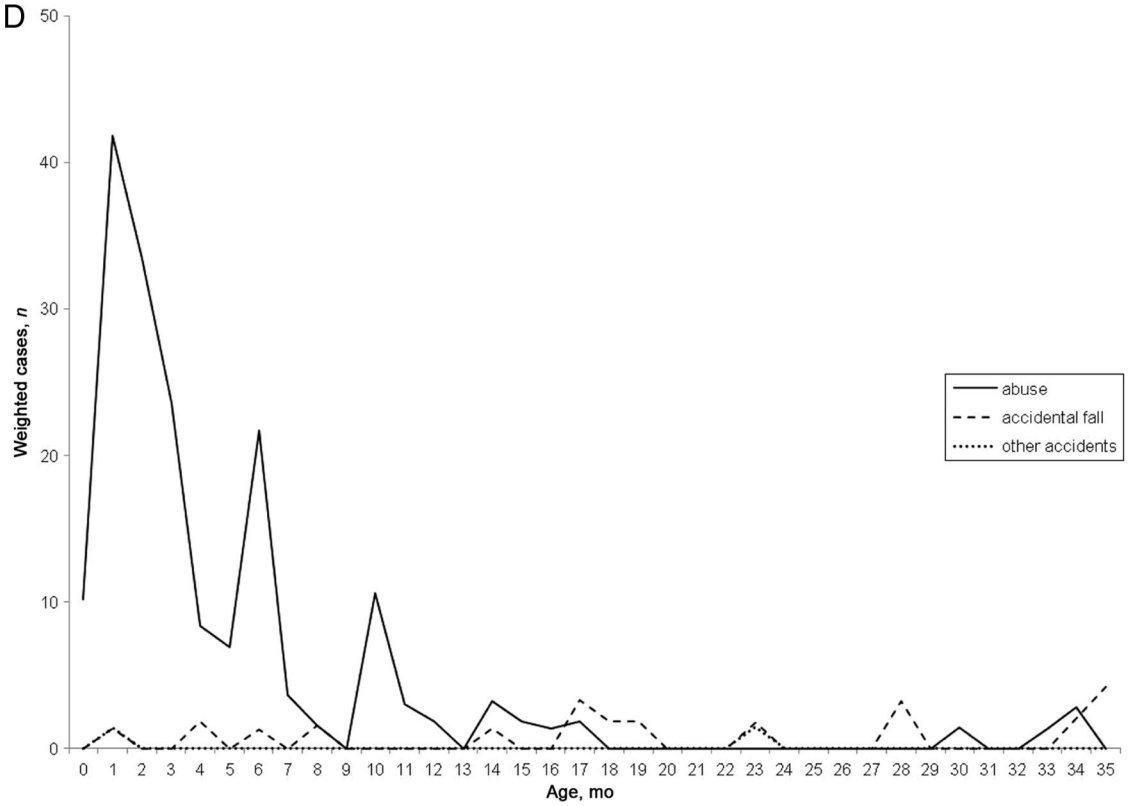


FIGURE 2
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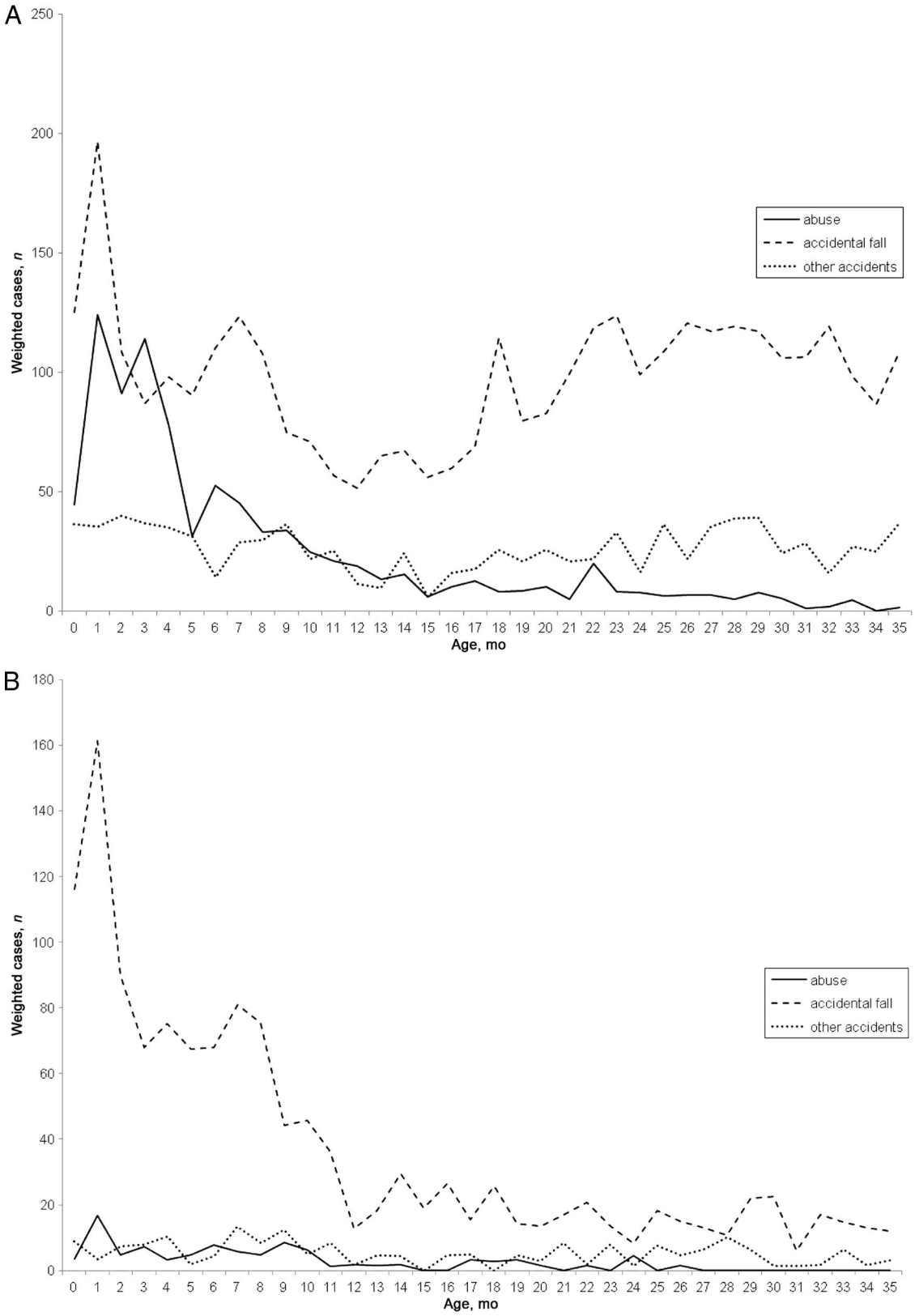
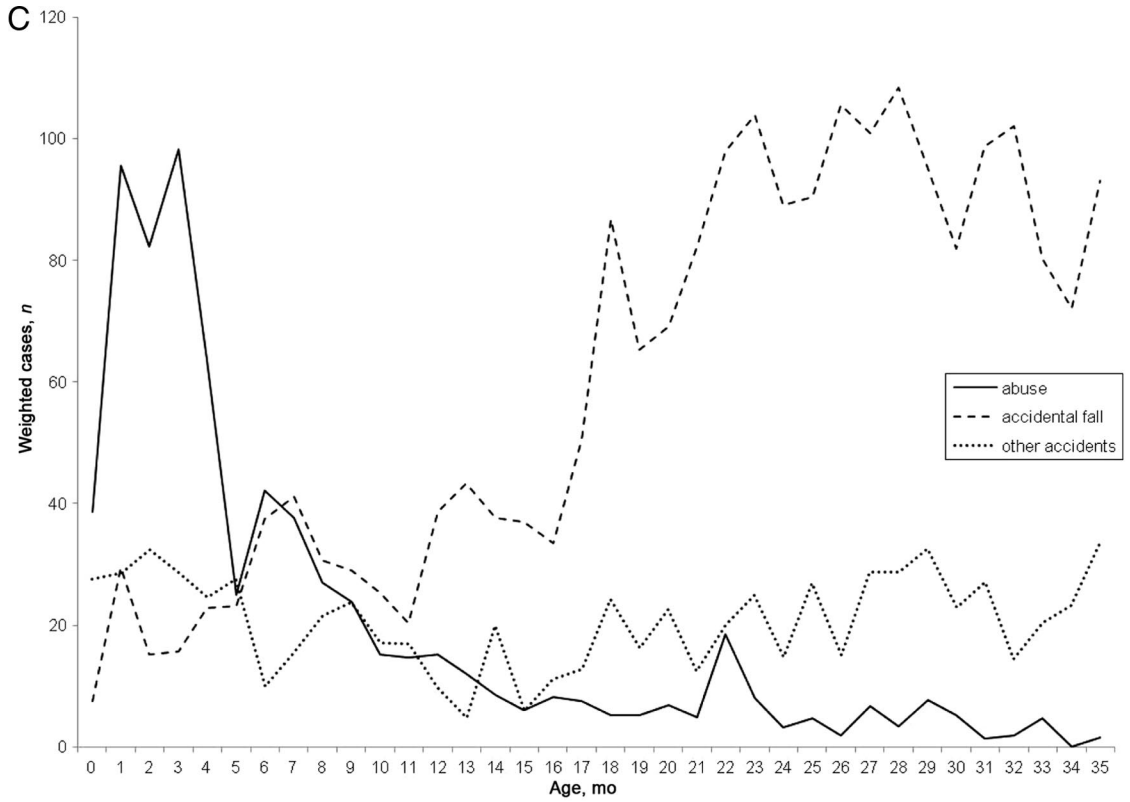


FIGURE 3

A, Causes of fractures only. Age data were available for 64.0% of eligible (weighted) cases (5375 of 8396 cases). B, Causes of skull fractures only. Age data were available for 71.1% of eligible (weighted) cases (1616 of 2274 cases). C, Causes of nonskull fractures only. Age data were available for 60.8% of eligible (weighted) cases (3621 of 5953 cases). D, Causes of skull and nonskull fractures. Age data were available for 81.1% of eligible (weighted) cases (137 of 169 cases).



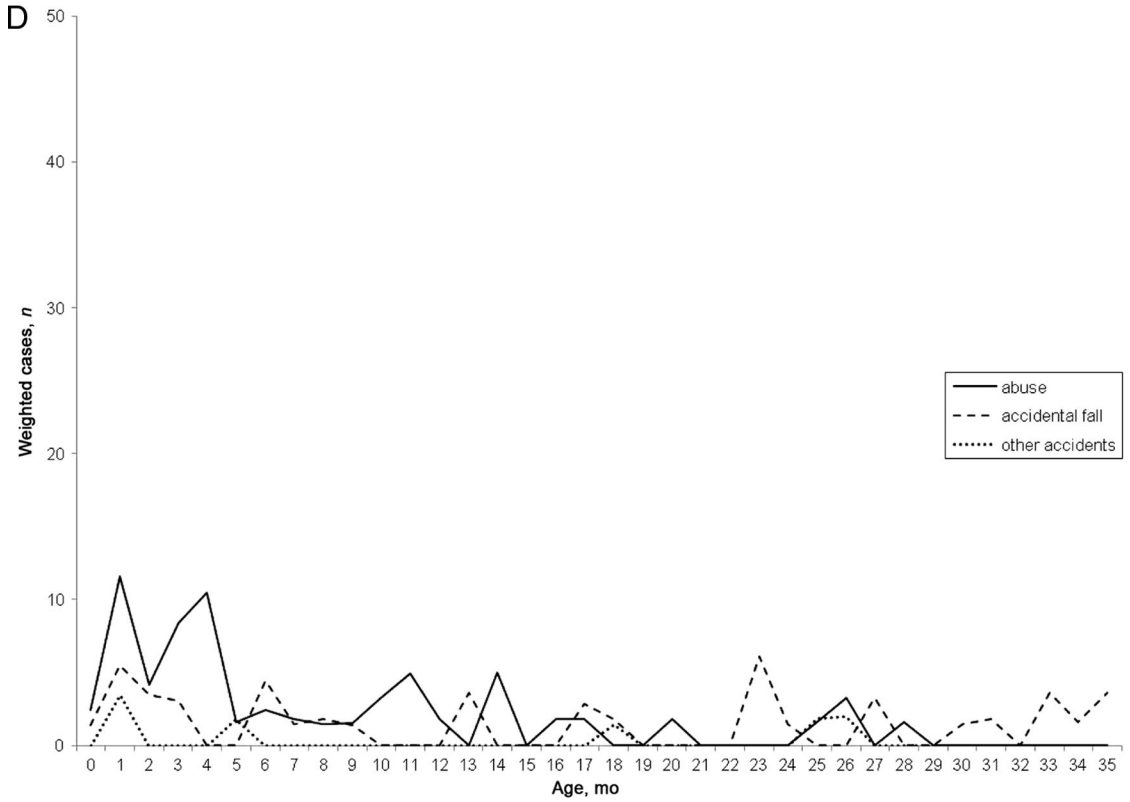


FIGURE 3
Continued.

health insurance of children with abusive versus accidental injuries, and important differences in the occurrence of accidental falls versus abuse during the first year of life. The incidence of TBIs and/or fractures attributable to abuse was 21.9 cases per 100 000 children <36 months of age and 50.0 cases per 100 000 children during the first year of life. Considerable overlap occurred between the 2 types of injuries; 28% of the abused children had both types of injuries. If only children with TBIs were examined, then 42% of the abused group with only fractures would be missed.

Because these types of abusive injuries are not rare, they should be the target of prevention programs that have become widespread in the United States. Such programs have used home visiting during the first few years of life to prevent abuse and neglect among socially high-risk, often first-time parents. None of the randomized trials of home visiting was large enough to study these types of abusive injuries but, as the number of home visiting programs increases,[14] there is an opportunity to examine whether these programs can prevent TBIs and/or fractures, the 2 most-common types of serious abusive injuries among young children.

More-targeted prevention has focused on abusive head trauma.[15,16] Because our data showed substantial overlap between TBIs and fractures attributable to abuse, it may be helpful for these targeted programs to broaden their focus and aim to prevent both types of abusive injuries, particularly because they focus on helping parents not hurt their crying infants.

There were 2 striking demographic differences between abused children and those with other causes of injury. The first was that abused children were substantially younger. Their younger age is likely attributable to their increased vulnerability to injuries caused by caretakers' maltreatment and the increased challenges of caring for young infants, such as managing their crying. In addition, it is not surprising that accidental injuries occurred at an older mean age, when children have better motor skills and therefore might be injured in falls.

The second difference was that abused children were more likely to be enrolled in Medicaid (or to have no insurance), compared with children with other causes of injury. This difference suggests that abused children are more likely to be from economically impoverished families, as reported previously.[17] Because 74.5% to 80.7% of the abused children were enrolled in Medicaid (or had no insurance), funding from this government program might aim to prevent the injuries themselves and thus decrease the costs of hospitalizations.

An alternative hypothesis to explain at least some of the differences in insurance status between abused and nonabused children relates to bias in the diagnosis of abuse by physicians. Previous studies demonstrated that physicians are more likely to suspect abuse and to report abuse to child protective services for minority children, compared with white children, and these minority children are more likely to have Medicaid as their health insurance.[18]

The examination of the patterns of injuries revealed 3 important findings related to accidental falls versus abuse during the first year of life. First, for children <2 months of age, the most-common cause of TBI without a fracture was an accidental fall; because children of this age are unlikely to roll over, these accidental falls likely occurred when a caregiver accidentally dropped the infant or fell while holding the infant. Second, in the first year of life, TBI with a skull fracture occurred more commonly because of an accidental fall than abuse. Third, almost all children in the first year of life with isolated skull fractures were injured in accidental falls.

These 3 findings all involve head injuries in very young children, and the first 2 concern infants with TBIs. Although the clinical literature emphasizes that TBIs (with or without skull fractures) in infants can be caused by abuse, limited data have been able to compare directly similar patterns of injuries attributable to abuse and accidental falls. Greenes and Schutzman[19] described 20 children <2 years of age who had TBIs and skull fractures and had no significant symptoms when admitted to the hospital. Of the 20 cases, 1 case was classified as abuse. Of the 19 children who were classified as having accidental injuries, most had small subdural, subarachnoid, or epidural hematomas, and 53% were <4 months of age. These results are similar to those shown in Fig 2B. A recent study by Wood et al[20] showed that infants with isolated skull fractures rarely had positive skeletal survey findings, which suggested that the risk of abuse was low. These results are consistent with our findings that isolated skull fractures were almost always attributable to accidental falls (Fig 3B).

This study has 4 limitations. The first is the reliance on E-codes and ICD-9-CM codes for abuse to ascertain abusive versus accidental injuries. For these codes to be used correctly, the physician must document the decision regarding the cause of the child's injury in the medical record, and then the hospital coder must interpret the physician's note correctly and use the correct code. In particular, there has been concern that physicians might underrecognize abuse and/or not document that diagnosis clearly, which would make administrative data sets, such as the KID, a poor source of data. Data

from a study using the 2003 KID showed that the diagnosis of abuse varied according to the type of hospital. Among patients with long-bone or skull fractures, the proportion of children with abusive injuries was largest in freestanding children's hospitals and smallest in community hospitals.[21] Whether this difference reflects physicians' willingness to diagnose abuse or variations in patients' characteristics because of differences in the severity of injuries is not clear. In contrast, Ellingson et al[7] showed that data from the KID could be used to provide incidence estimates of inflicted TBI in children <12 months of age that were very close to those provided in prospective, case-surveillance studies. In addition, we showed that the proportion of children who were <12 months of age and had abusive fractures was in the same range as that provided in the only published study that used surveillance to identify fractures resulting from abuse.[8]

A second limitation relates to missing data. Approximately 17% of the overall sample (13% of children with TBIs or TBIs and fractures) had no E-code or an E-code with an unspecified cause, and thus no cause of injury could be determined. In addition, the specific age of the child in months was missing in 17% to 39% of the cases used to generate the graphs shown in Figs 1 to 3. If children with missing age data were different from those with data included in the graphs, then our results might be biased.

A third limitation is that data from all states are not included in the KID, and different regions are not sampled uniformly. The 2006 KID does include 38 states, however, and the populations of these states represent >88% of the US population.

Finally, because the KID includes only hospitalized children, our results do not include nonhospitalized children with injuries. Although children with TBIs are likely to be hospitalized, children with fractures, especially those >12 months of age and those with isolated injuries, often are not hospitalized. Therefore, we have underestimated the incidence of abusive injuries.

CONCLUSIONS

By using a large national database of children hospitalized in 2006, we have shown that there is considerable overlap in the occurrence of abusive injuries attributable to TBI and fractures, and ≥75% of these children are enrolled in Medicaid or have no health insurance. Findings on the frequency of injuries attributable to abuse versus accidents in the first 36 months of life should be helpful for clinicians evaluating injuries in young children.

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