Incidence of Serious Injuries Due to Physical Abuse in the United States: 1997 to 2009

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**KEY WORDS**
abuse, epidemiology (injury), injury severity, incidence

**ABBREVIATIONS**
CPS—child protective services
ICD-9-CM—International Classification of Diseases, Ninth Revision, Clinical Modification
KID—Kids’ Inpatient Database
NCANDS—National Child Abuse and Neglect Data System
NIS—National Incidence Study
TBI—traumatic brain injury

Dr Leventhal and Ms Gaither both made substantial contributions to the concept and design of the study. Ms Gaither conducted the data analysis. Dr Leventhal and Ms Gaither reviewed the results. Dr Leventhal drafted the manuscript, and Ms Gaither provided critical revisions. Dr Leventhal and Ms Gaither approved the final version of the manuscript.

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**WHAT’S KNOWN ON THIS SUBJECT:** National data from child protective services agencies have shown a 55% decrease in the incidence of substantiated cases of physical abuse from 1992 to 2009, but no study has tracked the occurrence of serious injuries due to physical abuse.

**WHAT THIS STUDY ADDS:** Using national data from hospitalized children, we found a statistically significant increase in the incidence of serious injuries due to physical abuse from 1997 to 2009. These results are in sharp contrast to data from child protective services.

**BACKGROUND AND OBJECTIVE:** Although US child protective services data showed a 55% decrease in the national incidence of substantiated physical abuse from 1992 to 2009, no study has tracked the occurrence of serious injuries due to physical abuse. This study examined changes in the incidence of serious injuries due to physical abuse in hospitalized children from 1997 to 2009.

**METHODS:** The Kids’ Inpatient Database, a sample of discharges from hospitals in the United States, includes International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis and external cause of injury codes; it was prepared every 3 years from 1997 to 2009. Cases of serious physical abuse (eg, abusive head injury) were identified by using injury codes (800–959) and codes for abuse (995.50, 0.54, 0.55, and 0.59), selected assault codes (E960–966, 968), or perpetrator of abuse (E967). The weighted number of hospitalizations due to serious physical abuse was used to calculate the national incidence, and x² for linear trend compared over time the incidence for children <1 year of age.

**RESULTS:** The incidence per 100 000 children <18 years of age increased 4.9%: 6.1 (95% confidence interval = 5.4–6.8) for 1997, 6.0 (5.2–6.7) for 2000, 6.0 (5.3–6.7) for 2003, 6.1 (5.3–6.8) for 2006, and 6.4 (5.7–7.2) for 2009 (P < .01). The incidence for children <1 year of age increased 10.9% (P < .05).

**CONCLUSIONS:** Over 12 years, when substantiated physical abuse was declining, there was a small increase in the incidence of serious physical abuse in children <18 and <1 year of age. Pediatrics 2012;130:847–852
Few studies have examined changes over time in the occurrence of child physical abuse in the United States. The 2 major sources of national data that have been used to track changes are the yearly publication Child Maltreatment from the National Child Abuse and Neglect Data System (NCANDS) and the periodic reports from the National Incidence Studies (NIS), which were congressionally mandated studies conducted in 1979–1980, 1986–1987, 1993–1994, and 2005–2006. Both data sources have shown decreases over time in the occurrence of physical abuse. NCANDS collects yearly data from child protective services (CPS) agencies from across the country. These data have shown a 55% decline in the yearly incidence of substantiated cases of physical abuse from a peak in 1992 to 2009. The NIS have a more extensive methodology and have collected data from both CPS agencies and all mandated reporters in selected regions of the country. This approach has resulted in larger estimates of the number of physically abused children compared with the NCANDS data. NIS-4 showed a 23% decrease in the incidence of physical abuse compared with the incidence in NIS-3; this decrease is of borderline significance ($P < .10$).

Neither of these sources can provide data on children hospitalized with serious injuries due to physical abuse. A few studies have examined changes over time in children hospitalized with abusive injuries, but these have focused on specific types of injuries, such as fractures or traumatic brain injuries (TBIs), have collected data from single hospitals, or have examined trends over a short period of time.

No previous study has used national data to examine changes over time in the incidence of children hospitalized for all types of serious injuries due to physical abuse. Therefore, we addressed this problem by using data from a national hospital discharge database and examining the incidence from 1997 to 2009. If cases of serious physical abuse are decreasing in a similar fashion to physical abuse reported by NCANDS, then these results will reflect an important national trend. In contrast, if cases of serious physical abuse are not decreasing, it will be important to understand how the tracking of hospitalized cases of physical abuse differs from the tracking of cases of physical abuse substantiated by CPS.

## METHODS

Data for this study were obtained from the Kids’ Inpatient Databases (KIDs), which have been prepared every 3 years starting in 1997 by the Health Care Cost and Utilization Project; Each KID is a weighted US sample of discharges for 1 year from acute care hospitals in the project’s State Inpatient Database. For each year of the KID, a systematic sample is taken of 10% of the uncomplicated births and 80% of the complicated in-hospital births and other pediatric discharges. Weighting is then used to derive a national estimate; the weighting is based on 6 characteristics of the hospitals: region of the country, rural versus urban location, ownership/control, type of children’s hospital, bed size, and teaching status. Table 1 shows the sampling frame, including the number of hospitals, number of states, and the weighted number of discharges for the KID in 1997, 2000, 2003, 2006, and 2009. Each case in the KID has the child’s diagnosis codes and external cause of injury (E-codes) based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM). We restricted our sample to children <18 years of age to reflect the same age demarcation used by CPS agencies around the country. Cases were excluded if there was no information about the child’s age.

Physical abuse was defined using the same criteria that we used when identifying cases of physical abuse in the 2006 KID. We required 1 of 4 definitions:

1. An injury code (800–959) and either a code for child abuse (995.50, 0.54, 0.55, or 0.59) or the E-code for the identified perpetrator of child abuse (E967). To minimize the inclusion of children with nonacute consequences of the injury, we excluded cases with codes for “late effects” (905–909).

2. An injury code and E-code for assault (E960–E966, E968). To minimize the likelihood of including older children hurt in fights with peers or older persons, we excluded injuries due to air guns or firearms and injuries that occurred outside the home. For children >8 years of age, we excluded hospitalizations in which there was no E-code for location.

3. A code for child abuse or the E-code for perpetrator of abuse (E967) and at least 1 code that was consistent with abuse (eg, anoxic brain damage). These cases had no specific injury code in the range 800 to 959.

4. The code for shaken infant syndrome (955.55) and no specific injury code.
We also excluded cases coded as neglect (955.52), child sexual abuse (955.53), or rape (960.1) unless there was another child abuse code (999.5) or E-code for assault (E960–E966, E968).

ICD-9-CM codes (based on any of the codes provided for the case) were used to categorize the child’s injuries for each hospitalization. The injuries were grouped into 6 categories as described previously: TBI, fracture, skin injury and/or open wound, burn, abdominal injury, and other.10 The KID also provides information about demographics, including the child’s age, gender, race, and health insurance, whether the child died during the hospitalization; and the length of stay of the hospitalization.

To determine whether there were differences over time in the demographic characteristics of the abused children, for each year of the KID, we examined the child’s gender, race, and health insurance. For each of these variables, χ² was used to determine if there were statistically significant changes over time.

To calculate the incidence of abuse for each year of the KID, we divided the weighted number of hospitalizations due to abuse in children <18 years of age by the intercensal number of children at risk for the specific year of the KID.10 Confidence intervals were calculated by using the Taylor Series in SAS Version 9.2 (SAS Institute, Cary, NC). The statistical significance of changes over time in the incidence of abuse for each year of the KID was then assessed by using χ² for linear trend. In addition, because the rates of serious abusive injuries are highest in the first year of life, we compared the incidence over time for children aged <1 year and aged 1 to 18 years.

For each year of the KID, we calculated the average length of stay for the hospitalizations due to abuse and estimated the weighted number of children who died during the hospitalization due to abuse. To determine whether there were changes over time, analysis of variance was used to examine the mean lengths of stay, and χ² for linear trend was used to examine the incidence of deaths; incidence was calculated as described earlier.

We compared trends over time in hospitalizations due to abuse with the 2 other groups: hospitalizations due to nonabusive injuries, which included all children with injury codes but not classified as abuse, and all other hospitalizations. For each group, the incidence was calculated for each year, and χ² for linear trend was used to examine changes over time.

This study was considered exempt from approval by the Yale School of Medicine’s institutional review board.

RESULTS

Table 2 shows the characteristics of the children hospitalized for physical abuse from 1997 to 2009. Although there was a statistically significant difference in race/ethnicity over time (P < .0001), these differences were small. For example the percentage of white children decreased from 47.8% in 1997 to 46.3% in 2009. There was a large and statistically significant increase in children on Medicaid (from 59.0% in 1997 to 74.1% in 2009, P < .0001).

The majority of the injuries in each year of the KID were due to fractures (varying from the lowest of 40.2% in 1997 to the highest of 48.5% in 2009), skin or open wounds (35.3% in 2003 to 41.6% in 2009), and TBI (33.1% in 1997 to 39.2% in 2003). Burns, abdominal injuries, and other injuries were less common: ≤10% each year.

Table 3 and Figs 1 and 2 show the incidence and 95% confidence intervals of hospitalizations for serious abusive injuries for each year of the KID for children aged 0 to 18 and for the 2 age stratifications: those <1 year and those 1 to 18 years of age. Overall, the incidence increased 4.9% from 6.1 per 100 000 in 1997 to 6.4 per 100 000 children in 2009; the trend over time was statistically significant (P < .01). For children <1 year of age, the increase was 10.9% from 56.2 to 62.3 per 100 000 (P < .05). For the older children, there was a slight decrease of 9.1% from 3.3 to 3.0 per 100 000 (P < .05).

During this same time period, there were substantial decreases in children hospitalized in the United States. The incidence of hospitalizations for nonabusive injuries decreased by 20.5% from 292.7 per 100 000 children in 1997 to 252.7 in 2009 (P < .01). For all other

**TABLE 2. Characteristics of Children Hospitalized for Physical Abuse (Weighted %)**

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<td>Gender: male</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>NS</td>
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<tr>
<td>White</td>
<td>60.1</td>
<td>59.1</td>
<td>60.8</td>
<td>59.4</td>
<td>60.1</td>
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<tr>
<td>African American</td>
<td>29.7</td>
<td>28.3</td>
<td>26.7</td>
<td>25.6</td>
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<td>Hispanic</td>
<td>15.9</td>
<td>17.6</td>
<td>22.8</td>
<td>19.4</td>
<td>20.7</td>
<td></td>
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<tr>
<td>Other</td>
<td>6.7</td>
<td>8.3</td>
<td>7.5</td>
<td>9.7</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>Health Insurance</td>
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<tr>
<td>Medicaid</td>
<td>59.0</td>
<td>64.2</td>
<td>69.7</td>
<td>71.6</td>
<td>74.1</td>
<td>&lt;.0001</td>
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<tr>
<td>Private/HMO</td>
<td>28.2</td>
<td>26.5</td>
<td>21.3</td>
<td>18.6</td>
<td>17.7</td>
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<tr>
<td>Self-pay</td>
<td>7.4</td>
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</tr>
<tr>
<td>Other</td>
<td>5.4</td>
<td>3.3</td>
<td>4.9</td>
<td>5.3</td>
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Missing data were rare for gender and health insurance. For race/ethnicity, data were missing for 8% to 10% of the cases for each year. HMO, health maintenance organization; NS, not significant.
hospitals, the incidence per 100 000 children decreased by 10.5% from 3370.2 to 3017.1 per 100 000 children ($P < .01$).

The length of stay for the hospitalizations of the children with abusive injuries did not change over time (mean of 7.2 days in 1997 vs 7.1 days in 2009; $P = NS$). In contrast, there was a substantial increase in the incidence of deaths during the hospitalization in the abuse group. In 1997, the incidence of children dying due to abusive injuries was 0.25 per 100 000 children, and this increased to 0.36 per 100 000 children in 2009 ($P < .01$).

**DISCUSSION**

These results indicate that there has been no major decrease and, in fact, a small, but statistically significant increase in the incidence of hospitalizations of children with serious injuries due to physical abuse from 1997 to 2009. A major demographic change in the group of abused children over time was that the percentage of cases on Medicaid increased substantially from 59% to 74%. During this same time period, the length of stay for hospitalizations did not change, but the incidence of children dying in the hospital because of their abusive injuries increased. In marked contrast, the incidence of hospitalizations due to nonabusive injuries and due to medical and surgical problems showed a decrease from 1997 to 2009.

There are only a few studies examining changes over time in the occurrence of physical abuse in the United States. Finkelhor and Jones used national data collected by NCANDS to examine substantiated reports of child maltreatment and specifically cases of substantiated physical abuse from 1990 to 2009. They found a 55% decrease in the incidence of substantiated cases of physical abuse from a peak incidence in 1992 to 2009. Although the authors have suggested that this decrease reflects positive changes in the provision of services to children and families, there have been concerns that some of this decrease may be due to changes in reporting of cases to CPS agencies and changes in which cases get investigated by CPS and which cases are actually substantiated as physical abuse.

The only other national data in the United States that have been used to examine changes in the occurrence of physical abuse are derived from the four NIS studies. Consistent with the decrease in the incidence of substantiated cases of physical abuse based on the NCANDS data are the results of the NIS-4 (2005–2006) compared with the NIS-3 (1993–1994). When cases of “moderate injuries” (defined as injuries, such as bruises, that lasted ≥48 hours) were examined, there was a decrease of 23% from an incidence of 5.7 to 4.4 per 1000 children. This decrease, was noted over a period of time similar to that of the NCANDS data.

There are 2 potential reasons why serious injuries due to physical abuse have increased slightly (or stayed relatively stable) over 12 years, whereas substantiated cases of physical abuse have decreased substantially. First, each study might be measuring a different phenomenon. NCANDS data include all cases of physical abuse regardless of age or severity. The hospitalization data on abuse also include children of all ages, but 54% of these cases involve children <1 year of age. Thus, perhaps all physical abuse is decreasing in the United States, but injuries in very young children have not followed this overall trend. Against this possible explanation is the finding that there was no major decrease in the incidence of hospitalizations due to abusive injuries in children 1 to 18 years of age.

A second possibility to explain the difference in results relates to the occurrence of time trends that might affect who gets hospitalized for an injury due to physical abuse or who gets substantiated for physical abuse by CPS. For example, the number of hospitalizations of abused children would
increase over time if children with milder types of abusive injuries were more likely to be hospitalized over the 12-year period because of an increasing effort to improve evaluations and ensure safety of these children with mild injuries. This increase might mask a true decrease in the occurrence of serious injuries leading to hospitalization. Against this hypothesis is the fact that the mean length of stay did not change over the 12 years; also, the likelihood of dying due to abuse increased, suggesting that children identified though the hospital databases might have had more serious injuries over time.

Smaller studies have focused on specific types of injuries and have shown differences over time in the occurrence of fractures and head trauma due to abuse. Leventhal et al.4 showed a >50% decrease in the occurrence of abusive fractures in children <36 months of age at a single hospital from 1979 to 2002. The major decrease occurred when the time period of 1979 to 1983 was compared with 1991–1994; both of these time periods are earlier than the data tracked by the KID.

More recently, 2 studies have shown an increase in the occurrence of abusive head trauma due to the national US recession, which officially occurred from December 1, 2007 to June 30, 2009. In one study, hospitalized children were examined in 3 geographic regions, and the incidence of abusive head trauma in children <5 years of age increased from 8.9 (before the recession) to 14.7 per 100 000 children during the recession.5 In the other study, there was a doubling of the occurrence of cases of abusive head trauma at a single hospital when comparing 6 years before the recession to the period of the recession. Although the data from the KID show a slight increase in the incidence in 2009, it is difficult to attribute this small increase to the US recession.

A notable change during the study period was the percentage of abused children who were on Medicaid, which increased from 59% to 74%. That three-quarters of the abused children in 2009 were on Medicaid highlights the importance of poverty as a stressor for families and suggests that funding from Medicaid might target the prevention of these serious injuries. In 2009, 34% of US children were enrolled in Medicaid,14 which is substantially lower than the 74% of the abused children in this study.

At least 3 limitations should be noted. First, changes over time in the coding of causes of injuries may have affected our results. For example over time, documentation in the medical records concerning abuse may have become more specific, resulting in more cases of abuse being correctly coded by hospital coders and identified in the KID. If cases of serious physical abuse were, in fact, decreasing over time, then the improvement in coding of abuse may have masked a true decrease over time.

A second limitation is that we relied on ICD-9-CM codes to identify cases of children with serious injuries due to physical abuse. There are, however, limited published data on whether ICD-9 codes are accurate in identifying children hospitalized because of physical abuse. A study by Ellingson and Leventhal12 showed that the estimated incidence of inflicted TBI using data from the KID was comparable to the incidences derived from regional prospective studies suggesting that data from the KID are accurate. More recently, Hooft et al13 showed that the use of ICD codes at a single hospital was reasonably accurate in identifying cases of physical abuse as determined by child abuse pediatricians. In this study, the sensitivity of ICD-9 codes was 77%, and the specificity was 100%.

A third limitation is that we could not take into account changes over time in the quality of medical care. For example, improvements in prehospital care during the period of the study may have

FIGURE 2
Incidence per 100 000 children of hospitalizations of children aged <1 year (top) and 1 to 18 years (bottom) with serious injuries due to physical abuse stratified by age.
resulted in fewer deaths due to abuse before hospitalization. Over time, more of these children may have been hospitalized and died in the hospital (as opposed to before the hospitalization), resulting in a higher mortality rate in hospitalized children.

Because there has been no decrease in the incidence of hospitalizations due to serious abuse in children, our results highlight the need to develop prevention programs that can reduce this significant morbidity (and mortality). Such programs will require substantial resources, effective strategies to help parents and other caregivers respond in nonviolent ways to the stresses and frustrations of caring for young children, and the targeting of large numbers of families. In the 1990s, in response to a high rate of sudden infant death syndrome in the United States, a national campaign was successfully implemented to have all infants sleep in the supine position. This campaign resulted in a 50% decrease in the occurrence of the syndrome. A similar national campaign will be required to address serious abusive injuries in children.

In summary, our study shows that in the United States over a 12-year period (1997–2009), there was a slight increase in the incidence of children hospitalized with serious injuries due to physical abuse. These results, which are in sharp contrast to the marked decrease in substantiated cases of physical abuse based on data from CPS, highlight the challenge of using a single source of data to track a complex problem such as child physical abuse.

REFERENCES


**Incidence of Serious Injuries Due to Physical Abuse in the United States: 1997 to 2009**

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