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Deaths from Falls in Children: How Far is Fatal?

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The outcome of injury was determined in 317 children who were brought to a children's trauma center with a history from the caretaker that the child had fallen. Cases in which the clinicians' judgment was that an incorrect history had been given were included along with cases in which the history was not questioned. Seven deaths occurred in 100 children who fell 4 feet or less. One death occurred in 117 children who fell 10 feet to 45 feet. The 7 children who died in short falls all had other factors in their cases which suggested false histories. When children incur fatal injuries in falls of less than 4 feet, the history is incorrect. Long falls with an outdoor component are likely to be reliable data points for studies of children's injuribility.

Precise and certain differentiation of nonintentional injuries from inflicted injuries is extremely important in the management of injured children with histories discrepant from the injuries they show. Errors in diagnosis may be very costly. If inflicted injury cannot be proven to exist when it is present, children may be left in the care of persons who may injure them again, sometimes fatally. If the diagnosis is made incorrectly children may be removed from the care of their parents when that is not needed, and, conceivably, innocent persons could be convicted of crimes. Diagnosing child abuse medically is analogous to diagnosing cancer in that the risks of overlooking the problem may be fatal and the interventions available after the diagnosis is made are likely to be invasive and hazardous.

Whether a child's fatal injury is abusive often rests solely on the medical determination that the injury effects could or could not have been produced by the event described in the case history. While a number of studies[1-6] provide knowledge that can be applied to this determination, there is no comprehensive database on children's injuribility which supports highly reliable diagnosis, and the existing literature conflicts on the question of whether or not infants and children can receive fatal injuries in short falls.

The present study examines fatal outcome of injury in 317 infants and children who were seen at a children's trauma center with injuries and a history of having fallen. The purpose of the study was to determine the relationship of historical fall height to mortality, to assess the reliability of historical fall height, and to determine what types of fall histories might be used in establishing a database for children's injuribility.

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METHODS

The complete medical records of all children who were admitted to the Trauma Center at Children's Hospital-San Diego between August 1984 and March 1988 and for whom a mechanism of injury of "fall" had been recorded were reviewed to determine the fall height, the surface on which the child fell, the nature of the fall (whether free or interrupted), the person observing the fall, the diagnosis, and the outcome. The records included the prehospital care notes by first professional responders, emergency department notes, and hospital records from admission to discharge for the injury admission episode. In 23 of the cases the clinical staff had determined that the history given was unlikely to be true.

RESULTS

Table 1 displays the age and gender distribution of the 317 cases. The predominance of male toddlers and preschool children in this set of children who fell conforms to a pattern seen in many previous fall studies.

Table 2 displays the heights of the falls recorded for 283 cases. The remaining records provided no estimate of the height of the fall.

Table 3 displays the frequency of fatal outcome by the

TABLE 1
Gender and age of all children

	Number	Percentage
Gender		
Male	199	62.8
Female	118	37.2
Total	317	
Age (years)		
>1	30	9.5
1-3	145	45.7
4-6	61	19.2
7-12	65	20.5
13+	16	5.0
Total	317	

TABLE 2
Estimated fall heights

Fall Height (feet)	Number of Cases	Percentage of Total
1–4	100	35.3
5–9	65	23.0
10–14	75	26.5
15–19	24	8.5
20–29	17	6.0
30–45	2	0.7
Total	283	

TABLE 3
Case fatality rate by fall height

Fall Height (feet)	Number Died	Total	Case Fatality Rate (%)
1–4	7	100	7.0
5–9	0	65	0.0
10–45	1	118	0.8
Total	8	283	2.8

TABLE 4
Seven fatal cases with short falls; Type of fall

Standing Fall	2
Fall from Bed or Table	2
Fall Down Stairs	1
Fall in Arms of Adult	2

height of fall found in the history. Seven of 100 children died whose caretakers gave a history of a fall of 0 to 4 feet. No deaths occurred in 65 children who fell from 5 to 9 feet, and one death occurred in 118 children who fell from 10 to 45 feet. The fall that produced this single death in the children with "long" falls was not observed. The parents stated that their first knowledge that the 11-month-old child had fallen was when a neighbor brought the child to their door saying he had found the child beneath an open second story window. No detailed report of a scene investigation could be found for this case.

All of the children who died had head injuries as a cause of death consisting of subdural hematoma (mostly thin), cerebral contusion with brain swelling, or both, except for the child who presumably fell from the second story. This child had a markedly depressed parietal skull fracture with underlying bleeding, but survived his head injury and died 6 weeks later from sepsis complicating very severe and prolonged adult respiratory distress syndrome.

The types of falls given in the histories for the 7 children who died following short falls are shown in Table 4.

In the case with a history of a stairway fall the 11-month-old child was found unconscious at the foot of the stairs by a babysitter, but no one claimed to have witnessed the fall. This case was classified as a short fall because of the sitter's statement and because falls down stairs are believed to be series of short free falls.[7] In addition to a massive head injury this infant had small round bruises on both arms and bruising on the labia majora and one inner thigh. Two patients had histories of falling in the arms of an adult. In one the father stated that he fell against a crib while holding the 6-week-old infant 6 days before bringing her for care unconscious with agonal respirations. This infant had interhemispheric bleeding without a skull fracture and had conjunctival hemorrhages, bruising of the scalp, bruising on one ear, and retinal hemorrhages. In the other fall with an adult, the sitter stated that she had fallen on the child while going up stairs. The 13-month-old child had thin frontal and occipital subdural hematomas without a skull fracture, retinal hemorrhages, and an older healing tibial fracture. The head injury pathologic findings found in the seven cases by autopsy and clinical studies are shown in Table 5.

Although all seven patients had fresh subdural bleeding and cerebral edema, only one had a skull fracture.

Five of the seven fatal cases with short fall histories had "associated injuries" including old fractures, bruising on the trunk and extremities, genital injury, or more than one impact site on the head.

DISCUSSION

Diagnosis of classical "battered children" who are presented for care with multiple injuries in differing stages of healing is relatively simple for experienced physicians.[8,9] It is more difficult to be certain about children with a single "discrepant injury." Inflicted injury is often diagnosed when the clinician can state with a high level of certainty that the single injury seen in a child could not possibly have been produced by the event described by the caretaker. For the most part this discrimination is based upon the physician's clinical experience of children's "injuribility" and the limited empirical studies in the literature. Wissow and Wilson[10] stated the need for

TABLE 5
Seven fatal cases with short falls; head injury findings

Skull Fracture	1
Subdural Hematoma	7
Subarachnoid Blood	5
Cerebral Edema	7
Retinal Hemorrhage	5

TABLE 6
Seven fatal cases with short falls; associated injuries

Old Fractures	2
Bruises on Trunk or Extremities	3
Genital Injury	2
Two Head Impact Sites	2
No Associated Injury	2

a database of known accidents of various sorts which provide knowledge of children's injuribility. They suggested that the National Electronic Injury Study (NEISS) of the Consumer Product Safety Commission (CPSC) would be useful for this purpose. Chadwick[11] pointed out that the NEISS database led Sweeney[12] to conclude that children may die in falls as short as 1 foot, and that it may be seriously contaminated with inflicted injuries that are not screened out in the data collection process.

Hall et al.[2] reviewed records in the Medical Examiner's Office of Cook County, Illinois and found 18 cases in which a history of a fall of 3 feet or less was associated with fatal head injury. Their work omits the detailed information necessary to exclude inflicted injury, and many of those cases might be in that category.

Helfer's[3] classical study of children who fell while in the hospital provides a very useful and reliable set of events and effects and was recently replicated by Nimityongskul.[4] These two studies record the injuries noted in about 180 total small children who fell while in hospitals. The falls were all in the 3–4-foot range and the children had very minor injuries or were uninjured. The studies of Smith et al.[5] and of Barlow et al.[1] of long free falls of children from buildings found that the shortest falls that resulted in death were from the four-story level (or perhaps 30 feet). Snyder et al.[6] studied 100 falls of children and adults with personal scene investigation by the senior author and found one death in an apparent 10-foot fall of a child which was unobserved, but otherwise found that life-threatening injury required at least a 15-foot fall.

The data in the present study show an astonishing concentration of risk of death in the group with the shortest falls. Only 1 of 118 children died who were reported to have fallen from 10 to 45 feet. If the histories of short falls are accepted as correct, the conclusion would be reached that the risk of death is eight times greater in children who fall from 1 to 4 feet than for those who fall from 10 to 45 feet. Since this conclusion appears absurd, it is necessary to seek another explanation for the observed relationship.

In children whose injuries are inflicted, parents typically invent accident histories which they hope will be accepted by health care providers. Since most falls of over 10 feet usually require that the fall occur outdoors (from a window, balcony, or other such location), caretakers may not wish to risk the possibility that a history could be proven false by a neighbor or passerby. It is also very possible that many lay persons believe that short falls may be fatal for children and are surprised to encounter skepticism. The best explanation of the findings is that for the seven children who died following short falls the history was falsified.

The low case fatality rate in the 118 children who fell 10 to 45 feet is in keeping with the observations of Smith et al.[5] and of Barlow et al.[1] but not with the conclusions of Hall et al.[2] Since the current study was done in an area with a county-wide trauma system that provides for quick and sophisticated first responses and designated hospitals for all trauma cases, a low case fatality rate for children's falls would be expected. However, delay in care is a common feature in inflicted injuries to children, and was probably a factor in all seven children who died with histories of short falls. The delay in care eliminates much of the advantage provided by an organized trauma system.

Many of the records lacked details that would be useful in determining impact sites and impact energy in any very precise way. Hospital records typically lack this sort of detail, which can only be captured if skilled investigators examine fall scenes and interview all witnesses fairly soon after the event.

CONCLUSIONS

Falls of less than 4 feet are often reported in association with children's head injuries that prove to be fatal, but such histories are inaccurate in all or most such cases. Long falls outside of buildings are more likely to provide accurate data points for studies of children's injuribility, and research on children's injuribility should utilize these longer falls rather than short indoor falls witnessed by just one person.

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