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# The Mortality of Childhood Falls

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**Falls accounted for 5.9% of the childhood deaths due to trauma in a review of the medical examiner's files in a large urban county. Falls represented the seventh leading cause of traumatic death in all children 15 years of age or younger, but the third leading cause of death in children 1 to 4 years old. The mean age of those with accidental falls was 2.3 years, which is markedly younger than that seen in hospital admission series, suggesting that infants are much more likely to die from a fall than older children. Forty-one per cent of the deaths occurred from "minor" falls such as falls from furniture or while playing; 50% were falls from a height of one story or greater; the remainder were falls down stairs. Of children falling from less than five stories, death was due to a lethal head injury in 86%. Additionally, 61.3% of the children with head injuries had mass lesions which would have required acute neurosurgical intervention.**

**The need for an organized pediatric trauma system is demonstrated as more than one third of the children were transferred to another hospital, with more than half of these deteriorating during the delay. Of the patients with "minor" falls, 38% had parental delay in seeking medical attention, with deterioration of all. The trauma system must also incorporate the education of parents and medical personnel to the potential lethality of "minor" falls in infants and must legislate injury prevention programs.**

Trauma is the leading cause of death in children. Falls, as a sub-component, most frequently result in emergency room visits (5) and are the fourth leading cause of trauma deaths (1). In order to suggest means of preventing this unnecessary loss of life in children, it is important to understand the specific mechanism of deaths due to falls. With this knowledge, improvement in treatment and the prevention of morbidity and mortality should be possible. We reviewed the autopsy records of children who died from falls in the county of Cook, Illinois, which encompasses the city of Chicago and many of its suburbs, to better clarify these issues.

## METHODS

The records of pediatric deaths due to falls of the Cook County Medical Examiner's office from January 1983 through December 1986 were examined. The majority of patients had a full internal autopsy. Gross examination and fluoroscopy were used to determine the presence of fractures. The prehospital and hospital records of these patients are not kept with the autopsy reports due to legal reasons; however, a brief summary was available in most of the charts. During this 4-year time period, 30,843 persons of all ages were autopsied for unexplained deaths, of whom 2,066 (6.7%) were children 15 years of age or less. Of the pediatric deaths, 746 (36.1%) were due to trauma, with falls accounting for 44 (5.9%) of these deaths.

## RESULTS

Falls were the seventh most frequent cause of traumatic death for all children (burns, 29%; pedestrians, 16%; abuse, 9%; gunshot wounds, 8%; drowning, 8%; motor vehicle passengers, 7%; falls, 5.9%) but the third leading cause in the group aged 1 to 4 years (burns, 42.5%; abuse, 12.1%; falls, 11.8%). Of the 44 children suffering falls, 13 (30%) were girls and 31 (70%) were boys; 31 (70%) were black, 12 (28%) were white, and 1 (2%) was oriental. Sixty-four per cent were 2 years of age or younger; 11% were older than 5 years of age. The majority (59%) of the falls occurred between May and August and 15 were from a window or balcony with a height of one story or greater.

Based on the distance of the fall, victims could be divided into three groups (Table I). The first group is composed of eight children who fell from heights of five stories or higher. All of these had multiple lethal injuries and 75% were dead at the scene (DOA). Five of these children (mean age, 2.8 years) accidently fell from open windows or gratings; the remaining three were older (mean age, 10 years) who either jumped or were thrown. None of these deaths were deemed preventable.

The second group consisted of 18 children who fell from a height four stories or less, but higher than 3 feet.

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Seventeen of these children had a lethal head injury; one of these had an associated lethal injury and two had associated nonlethal injuries. One child who fell from a tree died from a liver laceration. Seven had delays of greater than 4 hours before definitive treatment with documented deterioration of five children during this time. Two children died during operative intervention at community hospitals (no pediatric or trauma surgeon) of injuries usually salvageable. The mean age of this group of children was 2.4 years. None of these children were DOA.

The final group of 18 children suffered "minor" falls sustained while running or from falls from furniture (less than 3 feet). These children all died from head injuries without any associated injury. Nine children had a delay in definitive treatment of greater than 4 hours with deterioration of eight. Six of these involved delays on the part of the parents and three of the six also had a delay due to hospital transfer. The one DOA in this group was an 8-month-old girl who fell off a couch onto a hard wood floor and was dead on arrival at the hospital. Her autopsy revealed a large acute subdural hematoma.

Of the 36 children in the latter two groups, one third were transferred to another hospital (one child was then transferred to yet another hospital) for care; 56% of these patients were at the primary receiving hospital more than 3 hours. The primary reason for delay was failure to recognize the injury, or performance of a CT scan. Of the patients transferred, 67% showed signs of deterioration between data recorded at the scene and at the final hospital. As not all data were listed, however, this figure could actually be higher. Additionally, nine children were initially normal after their falls but did not seek medical care until there was neurologic deterioration (range, 1 hour to 3 days).

Of the 31 children who died primarily of head injury, 19 (61.3%) had mass lesions (subdural or epidural hematomas, some associated with edema and/or subarachnoid hemorrhage), seven (22.6%) had edema and/or subarachnoid hemorrhage, and five (16.1%) had extensive brain lacerations; skull fractures were present in 42, 71, and 100%, respectively. Seventy-six per cent of those in the "minor" falls group had mass lesions.

TABLE I
**Summary of injuries per distance of fall**

| Distance of Fall | High (≥5th floor) | Mid | Minor (≤3 feet) |
|---|---|---|---|
| Number | 8 | 18 | 18 |
| Mean age (yrs) | 5.2 | 2.4 | 2.4 |
| % DOA | 75% | 0% | 5.5% |
| % Multiple lethal injuries | 100% | 5.5% | 0% |
| % Pure lethal head injury | 0% | 72% | 100% |
| % Lethal head plus nonlethal associated injuries | 0% | 17% | 0% |
| % Lethal injury without head injury | 0% | 5.5% | 0% |

## DISCUSSION

In comparing our study to other reviews of falls, several striking points are seen. In a review of children with injuries due to falls admitted to a Chicago medical center, Meller et al. found that the peak age of children falling was 6 years (7). This compares to that found in other studies (8) where 50% of falls occurred in children less than 5 years old. In our study, however, 89% of the children were less than 5 years of age and 64% were 2 years old or less. The first difference is that ours is an autopsy study, while the others are from hospital admissions. The second difference is that we have included all falls including those from running or falls from furniture as compared to the other studies which only included falls from heights. Nevertheless, if we look only at the children who fell from heights (eliminating as well the suicide, murder and fire-induced falls), the mean age of the remaining 23 children was still 2.3 years. This age difference could suggest that younger children are much more likely to die from a fall than are older children. The fact that these deaths were due to head injuries is consistent with the anatomic fact that younger children have softer cranial bones and thus less cerebral protection.

The second major distinction is the percentage of subdural and epidural hematomas in our study. Mayer et al. have shown that 30% of pediatric head trauma patients have significant mass lesions and thus operative neurosurgical intervention is often unneeded (6). This fact, along with interest in the nonoperative approach to abdominal injuries in children, has led some (4) to suggest that pediatricians trained in emergency medicine are better qualified to deliver care to pediatric trauma patients than either general or pediatric surgeons. From this study, however, it is clear that there is a need for trained pediatric neurosurgeons, as 61.3% of the children had mass lesions requiring neurosurgical intervention. In fact, as stated by Velcek (10), the delayed deaths of the children with head trauma illustrate the requirement of the "skill and continued availability of a neurosurgical team." If a neurosurgeon is not available, then someone with surgical experience must be immediately available for intervention.

While some of the "minor" falls may have been secondary to abuse despite negative investigations (all of these had intense police investigation to rule out abuse), it is important that two of these falls did occur under medical observation. "Minor falls" can be lethal, especially in a toddler, and must be evaluated. It is rather disconcerting, however, that of the final two groups, 42% suffered injuries that are usually associated with survival had the injuries been immediately recognized and aggressive resuscitation and definitive treatment initiated. Additionally, we have found, as have other authors (2, 8), that it is extremely rare to have visceral, thoracic, or non-skull fracture injuries in children who fall from less

than 3 floors. It is, in fact, possible to suggest that if these injuries are found in a child with a fall from less than 3 stories, one should suspect abuse as the etiology of the injury.

The purpose of this study was to seek means to improve the treatment and the prevention of childhood injuries. A 61% incidence of potential survivors is unacceptable. With the advent of pediatric trauma centers (such as those designated by legislation in the city of Chicago in November 1986), one would expect that the delays in treatment would be avoided. This is, however, only the first step. A means of educating parents regarding falls must be implemented. If the parents of 20% of these children had sought medical care sooner, their deaths could possibly have been prevented. Additionally, a fall prevention program like that instituted in New York City (9) with provision of barriers over windows, would have prevented the deaths of the 19 (43%) children who fell from windows. One 2-old child was left on a table next to an open window on the ninth floor of an apartment building while her mother answered the door. A child playing on a bed or table next to an open window is in reality playing Russian roulette, yet we allow it to happen. Finally, again as shown by other authors (3), a fair number of our records indicated that the child was being watched by an "older" sibling or by a friend who "fell asleep on the couch." In essence, these children were unattended. Society must provide a means of child care for parents so that their children are not unsupervised while the parent works or must be away from home. Moreover, parents must be educated to understand the necessity of seeking appropriate medical care if their children do fall, *regardless* of the height. We cannot expect young children to understand the dangers of their environment, so we must protect them. As physicians and child advocates, we must push for legislation to provide this protection.

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