

# AMERICAN ACADEMY OF PEDIATRICS

Committee on Injury and Poison Prevention

## Falls From Heights: Windows, Roofs, and Balconies

**ABSTRACT.** Falls of all kinds represent an important cause of child injury and death. In the United States, approximately 140 deaths from falls occur annually in children younger than 15 years. Three million children require emergency department care for fall-related injuries. This policy statement examines the epidemiology of falls from heights and recommends preventive strategies for pediatricians and other child health care professionals. Such strategies involve parent counseling, community programs, building code changes, legislation, and environmental modification, such as the installation of window guards and balcony railings.

ABBREVIATIONS. CPSC, US Consumer Product Safety Commission; AAP, American Academy of Pediatrics.

### INTRODUCTION

After motor vehicle-related injuries, falls of all kinds are the second leading cause of death from unintentional injury in the United States, accounting for more than 13 000 deaths during 1998 among persons of all ages, 126 of which were children 14 years and younger.<sup>1</sup> Falls are the leading cause of nonfatal injury, with several hundred thousand hospitalizations annually and almost 9 million persons treated in emergency departments who do not require hospitalization.<sup>2</sup> Although falls are the most common cause of childhood injury, these injuries are rarely fatal, in contrast with a high rate of fall-related mortality among the elderly.<sup>1,3,4</sup> Fatalities occur primarily when children fall from great heights (greater than 2 stories or 6.7 m [22 ft]), or when the head of a child hits a hard surface, such as concrete. Falls from heights greater than 2 stories can include falls from roofs, windows, and balconies.<sup>5-7</sup> The purpose of this statement is to review the epidemiology of falls from heights in children and to suggest strategies for prevention.

Falls from heights are a major problem in urban areas, especially for children living in multiple-story, often deteriorating, low-income housing.<sup>5-7</sup> In some urban areas, falls have represented up to 20% of the deaths of children from unintentional injury, as compared with an average of 1% to 4% nationally.<sup>1,8,9</sup> The majority of fall-related fatalities among children are associated with falls from heights, most from 3 stories or higher. Falls from 1 or 2 stories are more frequently nonfatal, but second-story falls may cause

serious injuries (D. Tinsworth, US Consumer Product Safety Commission [CPSC], written communication, June 13, 1994).<sup>5,7</sup> The falls from greater heights tend to cluster in the summer months, presumably because windows are more likely to be open and children are more likely to be playing on fire escapes, roofs, and balconies.<sup>5,7,8,10</sup> Although the average age of patients injured in falls from heights is approximately 5 years, the age distribution is bimodal; preschool children usually fall from windows, and older boys fall from dangerous play areas, such as rooftops and fire escapes.<sup>5,6,8,11</sup> African American and Latino children are overrepresented in published series of falls from heights in which race or ethnicity is reported, probably reflecting their increased likelihood of living in urban, multiple-story low-income housing.<sup>11,12</sup> Overall, fall-related injuries to boys outnumber those to girls by approximately 1.5:1 to 2:1, as with most other injuries.<sup>5,7,8,10-16</sup>

The nature of the injuries to children when they fall from heights has been studied extensively.<sup>11,13-17</sup> Data from the CPSC on the approximately 4700 children who were examined in emergency departments because of falls from windows during 1993 indicate that 90% fall from the first and second stories and that 45% had injuries defined by the CPSC as "serious," such as fractures, internal injuries, concussions, intracranial hematomas, and intracranial hemorrhages. Of those injured, 28% were admitted to the hospital compared with 4% for all consumer product-related injuries reported to the CPSC during 1993. Approximately one third of children sustained only minor injuries, such as contusions, abrasions, and lacerations.<sup>11</sup> These are usually young children who fall 1 or 2 stories. Fractures are the most common of the serious injuries and the radius, ulna, and femur are the most frequent sites.<sup>11,16,17</sup> Rib, spine, pelvis, and calcaneus fractures are much less common among children than among adults. Children tend to use their arms to protect their heads, and they have relatively flexible bones.<sup>11,15,17</sup> Multiple fractures are common, especially those resulting from falls from greater heights. Craniocerebral trauma is frequent, particularly in fatal falls.<sup>15,17</sup> Abdominal and chest injuries are relatively uncommon in falls from 1 or 2 stories, but they are more frequent in falls from greater heights and in fatal falls.<sup>5,10,15,17</sup> In general, the greater the height from which the child falls, the more severe the injury. However, the nature of the surface onto which the child falls (concrete and trash are most common; softer surfaces improve outcome<sup>13,14,18</sup>) and the degree to which the fall is broken on the way down modify the pattern and sever-

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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ity of injuries.<sup>5,6,11,14–16,18</sup> Children younger than 3 years are much less likely to have serious injuries than older children who fall the same distance. It is thought that, because younger children have more fat and cartilage and less muscle mass than older children, they better dissipate the energy transferred by the fall.<sup>11</sup>

Because witnessed falls of 2 stories or less usually do not result in serious injury, child abuse should be considered in children with serious injuries from falls that were reportedly from lower levels, especially if the fall was unwitnessed.<sup>19–22</sup> One large series reported that about one fourth of the falls were “not accidents”; some children jumped to avoid beatings or fires, some were pushed by siblings or parents, and some attempted suicide (all the suicide attempts were adolescents).<sup>14</sup>

Permanent physical sequelae—primarily orthopedic problems related to fractures and neurologic problems ranging from mild to severe—occur in 4% to 22% of children who survive serious falls.<sup>10,11,13,14,17</sup> One study reported a significant incidence of posttraumatic psychiatric and behavior problems.<sup>14</sup>

The economic costs of these injuries from falls are considerable. In Los Angeles County, where falls are possibly less frequent than in the northeast, the annual hospital charges from 1986 to 1988 were more than \$600 000, or about \$5000 per child admitted with fall-related injury; almost half of these charges were paid by public assistance.<sup>14</sup> Data compiled by the National Center for Health Statistics National Hospital Ambulatory Medical Care Survey for 1992–1994 revealed a national cost of \$958 million for emergency care for children who were seen for falls. Although fewer than 3% were falls from buildings or extreme heights, they would still account for almost \$10 million annually, including 26% paid by Medicaid.<sup>23</sup>

Case series have reported predisposing factors for fall injuries: a history of previous major unintentional injury to the patient or siblings; neurologic disorders, such as seizures, developmental delay or hyperactivity; and documented parental neglect.<sup>5,8,10</sup> The families of the victims are more likely than the general population to experience social and demographic factors such as poverty, single-parent households, inadequate child care, and acute stressors such as recent moves, illnesses, and job changes.<sup>8</sup> Some central-city residents may have moved recently from rural areas and may be unfamiliar with the hazards of living in multiple-story dwellings.<sup>5</sup>

### PREVENTION

A number of strategies, some of which have documented effectiveness, have been suggested to prevent children falling from heights. Parent counseling has been effective in preventing infant falls and other injuries and should be part of any prevention program.<sup>20,22,24–26</sup>

Considerable success has been reported with modification of the physical environment. Spacing of railings determines how well they function to prevent falls from balconies, decks, porches, and bleachers.

Widely spaced rails are ineffective barriers because they permit a child's body to slip through.<sup>27</sup> Virtually all children younger than 6 years can slip through a 6-in opening, and none older than 1 year can pass through a 4-in opening.<sup>27</sup> This information resulted in the adoption of the 4-in spacing by all 3 of the regional building code organizations in the United States. To prevent falls from balconies, the building codes in many communities now require railings through which a child cannot pass.<sup>28</sup> All local building codes dealing with new construction should be made to conform with the national codes that currently recommend 4-in openings between vertical (not horizontal) bars. Because the codes apply only to new construction, retrofitting of older dwellings also should be encouraged. Most codes specify railing heights of 36 in. Although an increase of railing height to 4 to 5 ft would add protection, aesthetic concerns are likely to impede any efforts for change.

Outside fire escapes are unnecessary in modern buildings that use fire-resistant techniques such as internal fire stairs, but it is unlikely that outdoor escapes can be eliminated from older housing, and is it unlikely that urban housing will be air-conditioned, reducing the need to open windows during hot weather. Providing safe ground-level play areas with climbing equipment has been suggested as a strategy for avoiding the falls from heights related to children playing on fire escapes and roofs.<sup>6</sup>

Because the majority of serious injuries are related to falls from windows,<sup>13,14,17</sup> strategies designed to prevent these falls should have a substantial effect. Modern window screens, although easily removable to allow for escape during residential fires, are designed to keep insects out of the house and do not provide a barrier to falls.<sup>24</sup> “Child safety” window screens made of steel are available and are used in new construction in some areas. These screens can withstand 67.5 kg (150 lb) of pressure, similar to the standard for window guards, and need replacing less often, but adding them to existing construction would be costly.

The installation of window guards is a proven preventive strategy. In 1976, the New York City Board of Health, noting that window falls accounted for 12% of deaths from unintentional injury of children younger than 15 years, passed a law requiring the owners of multiple-story dwellings to provide window guards in apartments where children 10 years and younger reside. This law was passed after the implementation of a pilot program combining education with the provision of free window guards. The pilot program resulted in a 35% reduction in deaths attributable to falls from windows and a 50% reduction in incidents; no child fell from a window equipped with a window guard.<sup>7</sup> The mandatory program resulted in a reduction of up to 96% in admissions to local hospitals for the treatment of window-fall-related injuries.<sup>14</sup> Follow-up through 1993 revealed a continuing downward trend.<sup>29</sup> Education is important for teaching the appropriate installation of window guards. Despite the proven effectiveness of window guards, other major cities have been slow to adopt similar codes. The building

code in Chicago requires window guards if the height of the window sill is less than 2 ft above the floor, but enforcement is reportedly ineffective.<sup>10</sup> A voluntary ordinance in Boston encourages but does not mandate landlords to install window guards. The first 2 years' data after initiating this program showed an 83% decrease in hospitalizations for the treatment of injuries attributable to falls from windows, and there were no deaths, compared with 3 deaths during the 2 years preceding the program.<sup>30</sup> A survey of building codes in several states found no regulations requiring window guards, although New Jersey has since passed a law similar to that of New York City.<sup>31</sup> Some states prohibit or limit window guards in the interest of providing fire egress.<sup>13</sup>

One survey of hardware stores found that the only devices available were specifically designed and advertised to keep intruders out; they were recommended for use on first floor windows.<sup>13</sup> These devices were expensive (approximately \$50) and difficult to install.<sup>13</sup> Security devices are designed to keep people out, and window guards are designed to keep people in—except for necessary egress in the event of fire. It is easier to find inexpensive window guards (starting at \$6) in cities where window guards are required, especially when public health programs have developed networks of stores that offer them. Window stops are available that prevent sliding windows from opening more than 4 inches. They are available at hardware stores for around \$2 and are easy to install. Window guards can be obtained to fill the entire opening of a sliding or casement window. However, currently designed window guards are best suited for double-hung (sash-hung) windows. If the guard does not fill the entire opening of the window, additional devices, “L-stops,” also are recommended to restrict the opening of the window above the top bar of the guard to no more than 4.5 in. L-stops are not to be used on windows designated for egress, that is, windows that are located less than 75 ft above the ground.<sup>32</sup>

Fire protection professionals have great concerns about the use of *fixed* window bars (security bars) that prevent egress or access by fire fighters. It is important to install *operable* window guards that can be released or removed without the use of a separate key or excessive force. Operable guards must be too difficult for a child to release but easy enough for an adult or teenager to release. Examples of operable guards include built-in bars that appear automatically as the window is raised, guards on a hinge that swing in when a “pin” is released, and a slide-out model that requires the simultaneous depression of 2 pins for removal. Fire codes in some communities prohibit the use of fixed bars on emergency and fire escape windows. Organizations of fire protection professionals decry their use, especially on first and second floors, but data are scarce that would permit the risk-benefit consideration of the use of operable guards, especially on higher floors.<sup>33</sup> Recent data on the New York City experience showed no increase in the number of deaths attributable to residential fires (in fact, there was a decrease) after the introduction of window guards as required by city ordinance.<sup>29</sup>

## RECOMMENDATIONS

1. Pediatricians should give the following anticipatory guidance about prevention of falls from heights to parents of children who live in multiple-story dwellings:
  - Supervise small children at all times, especially if windows are open.
  - Install locks on windows to prevent sliding windows not intended for egress from opening more than 4 in.
  - Open double-hung windows from the top only.
  - Fixed guards, commonly used to prevent intrusion, should not be used, because they may prevent egress in the case of fire.
  - Install operable window guards on second- and higher-story windows (unless prohibited by local fire regulations). Window screens are designed to keep insects out, but because they are not strong enough to keep children inside, they will not prevent falls from windows.
  - Discourage or prohibit children from playing on fire escapes, roofs, and balconies, especially those that are not adequately fenced with vertical bars that have openings of 4 in or less. Encourage the use of ground-level safe play areas, such as public parks and playgrounds. Ideally, these areas have been inspected and found safe by a nationally certified playground inspector.
  - Avoid placing furniture, on which children may climb, near windows or on balconies.
2. Pediatricians should advocate for community-wide programs to encourage the use of window guards. Public health authorities, in conjunction with fire prevention officials, should guide such programs so that regulations may be based on concerns about both fire safety and fall prevention.
3. The American Academy of Pediatrics (AAP), state chapters, and local pediatricians should work with manufacturers of windows and window guards to encourage them to develop and make more widely available additional products that can prevent falls and allow egress in fires. Examples are windows that cannot be pushed out or up by a child and window guards with safety catches that can be operated only by adults.
4. Legislation requiring landlords to install releasable window guards or window stops above the ground floor in multiple-story dwellings where children live should be developed. Community outreach and education are important components of programs to prevent falls from heights. In many cities, the local government housing authority, a major landlord for low-income people, along with the AAP state chapters and local pediatricians, should take the lead in encouraging the installation of window guards.
5. Building codes should ensure that balconies, decks, porches, bleachers, roofs, and fire escapes have railings with vertical openings not greater than 4 in.



6. Local communities and recreation departments should develop strategies to reduce the number of children playing in dangerously high places. Such strategies might include the expansion of safe public playground activities, including child care and recreational programs, as well as attempts to make streets and public areas safer for children by implementing programs such as neighborhood watch and crime prevention.
7. Whenever possible, grass or shrubbery should be planted at the bases of tall buildings to soften the impact surface.

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REFERENCES

1. Centers for Disease Control and Prevention. *Injury Mortality Reports*. Available at: <http://webapp.cdc.gov/sasweb/ncipc/mortrate.html>. Accessed March 15, 2001
2. National SAFE KIDS Campaign. *Falls Fact Sheet*. Washington, DC: National SAFE KIDS Campaign; 1998
3. Baker SP, O'Neill B, Ginsburg MJ, Li G. *The Injury Fact Book*. 2nd ed. New York, NY: Oxford University Press; 1992
4. Mosenthal AC, Livingston DH, Elcavage J, Merritt S, Stucker S. Falls: epidemiology and strategies for prevention. *J Trauma*. 1995;38:753–756
5. Sieben RL, Leavitt JD, French JH. Falls as childhood accidents: an increasing urban risk. *Pediatrics*. 1971;47:886–892
6. Garrettson LK, Gallagher SS. Falls in children and youth. *Pediatr Clin North Am*. 1985;32:153–162
7. Spiegel CN, Lindaman FC. Children can't fly: a program to prevent childhood morbidity and mortality from window falls. *Am J Public Health*. 1977;67:1143–1147
8. Bergner L, Mayer S, Harris D. Falls from heights: a childhood epidemic in an urban area. *Am J Public Health*. 1971;61:90–96
9. Waller AE, Baker SP, Szocka A. Childhood injury deaths: national analysis and geographic variations. *Am J Public Health*. 1989;79:310–315
10. Musemeche CA, Barthel M, Cosentino C, Reynolds M. Pediatric falls from heights. *J Trauma*. 1991;31:1347–1349
11. Meller JL, Shermeta DW. Falls in urban children: a problem revisited. *Am J Dis Child*. 1987;141:1271–1275
12. Velcek FT, Weiss A, DiMaio D, Koltz DH Jr, Kottmeir PK. Traumatic death in urban children. *J Pediatr Surg*. 1977;12:375–384
13. Lehman D, Schonfeld N. Falls from heights: a problem not just in the northeast. *Pediatrics*. 1993;92:121–124
14. Barlow B, Niemirska M, Gandhi R, Leblanc W. Ten years of experience with falls from a height in children. *J Pediatr Surg*. 1983;18:509–511
15. Smith MD, Burrington JD, Woolf AD. Injuries in children sustained in free falls: an analysis of 66 cases. *J Trauma*. 1975;15:987–991
16. Reynolds BM, Balsano NA, Reynolds FX. Falls from heights: a surgical experience of 200 consecutive cases. *Ann Surg*. 1971;174:304–308
17. Roshkow JE, Haller JO, Hotson GC, Sclafani SJ, Mezzacappa PM, Rachlin S. Imaging evaluation of children after falls from a height: review of 45 cases. *Radiology*. 1990;175:359–363
18. Mathis RD, Levine SH, Phifer S. An analysis of accidental free falls from a height: the "spring break" syndrome. *J Trauma*. 1993;34:123–126
19. Chadwick DL, Chin S, Salerno C, et al. Deaths from falls in children: how far is fatal? *J Trauma*. 1991;31:1353–1355
20. Williams RA. Injuries in infants and small children resulting from witnessed and corroborated free falls. *J Trauma*. 1991;31:1350–1352
21. Reiber GD. Fatal falls in childhood: how far must children fall to sustain fatal head injury? *Am J Forensic Med Pathol*. 1993;14:201–207
22. Helfer RE, Slovis TL, Black M. Injuries resulting when small children fall out of bed. *Pediatrics*. 1977;60:533–535
23. Weiss HB, Mathers LJ, Forjuoh SN, Kinnane JM. *Child and Adolescent Emergency Department Databook*. Pittsburgh, PA: Center for Violence and Injury Control, Allegheny University of the Health Sciences; 1997: 39–41, 92
24. Kravitz H. Prevention of accidental falls in infancy by counseling mothers. *IMJ Ill Med J*. 1973;144:570–573
25. Bass JL, Christoffel KK, Widome M, et al. Childhood injury prevention counseling in primary care settings: a critical review of the literature. *Pediatrics*. 1993;92:544–550
26. American Academy of Pediatrics. *The Injury Prevention Program (TIPP)*. Elk Grove Village, IL: American Academy of Pediatrics; 1994
27. Stephenson EO. The silent and inviting trap. *Building Off Code Administrator*. 1988:28–33
28. Stephenson EO. The elimination of unsafe guardrails: a progress report. *Building Standards*. 1993:12–15
29. Bijur PE, Spiegel C. Window fall prevention and fire safety: 20 years of experience in New York City. *Pediatr Res*. 1996;39:102A
30. Vinci RJ, Freedman E, Wolski K. Preventing falls from windows: the efficacy of the Boston window falls prevention program. *Arch Pediatr Adolesc Med*. 1996;150:32
31. Landlords must provide window guards for kids. *The Record*. Trenton, NJ: Bergen Record Corp. June 10, 1995:A4
32. Bush VR. *Handbook to the Uniform Building Code: An Illustrative Commentary*. Whittier, CA: International Conference of Building Officials; 1998
33. Miller AL. Locked in or locked out? the conflict between security measures and fire safety. *NFPA J*. 1994;88:110–117

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