

# Falls in children birth to 5 years: Different mechanisms lead to different injuries

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<b>BACKGROUND:</b>	Falls are the most common cause of injury-related hospitalization in children younger than 5 years old. Most anticipatory guidance surrounding falls is around falls from windows or stairs; however, falls from furniture also are important causes of morbidity. The purpose of this study was to compare the number of children injured, ages of injured children, and injuries sustained in falls from furniture and falls from stairs in hospitalized children younger than 5 years.
<b>METHODS:</b>	All records of individuals from 0 year through 4 years, hospitalized at our institution for a fall from furniture or stairs between January 1, 1996, and December 31, 2006, were retrospectively reviewed. A standard data set was abstracted from each chart. Frequencies were used to characterize the study population. $\chi^2$ and $t$ tests were used to determine differences between groups.
<b>RESULTS:</b>	A total of 171 patients were hospitalized for falls from stairs and 318 for falls from furniture. There were no differences between the groups with regard to age, sex, race, type of insurance, length of stay, Injury Severity Score, or total cost. The most common pieces of furniture from which children fell were beds (33.0%), couches (18.9%), and chairs (17.9%). Children who fell from stairs were significantly more likely to have injuries to their head (64.3% vs. 38.1%); those that fell from furniture were more likely to sustain arm injuries (33.3% vs. 9.9%). There were significantly more skull fractures in those that fell from stairs (39.8% vs. 20.1%) and humerus fractures in those that fell from furniture (30.8% vs. 9.4%) ( $p < 0.001$ ). Falls from furniture increased during the study period, while falls from stairs fell; the difference was not statistically significant, however.
<b>CONCLUSION:</b>	Falls from furniture and stairs are important causes of morbidity in children. More children were hospitalized for falls from furniture than from stairs. Falls down stairs are decreasing while falls off furniture are increasing. More anticipatory guidance should be developed and given to families regarding falls from furniture to help prevent these injuries. ( <i>J Trauma Acute Care Surg</i> . 2012;73: S254–S257. Copyright © 2012 by Lippincott Williams & Wilkins)
<b>LEVEL OF EVIDENCE:</b>	Prognostic/epidemiologic study, level III.
<b>KEY WORDS:</b>	Falls; furniture; child; falls from stairs.

According to the Centers for Disease Prevention and Control, unintentional falls were the leading cause of nonfatal injuries in children 0 year through 4 years from 2001 to 2009. They result in more than 1 million injuries treated in emergency departments and more than 10,000 hospitalizations annually.<sup>1</sup> From 1999 to 2007, falls were the sixth leading cause of unintentional injury-related death in children from birth through 4 years.<sup>1</sup> It can be easily concluded from these data that falls are a significant cause of both morbidity and mortality in children in the United States.

Although falls cause significant morbidity and mortality, most of the anticipatory guidance recommended by the American Academy of Pediatrics for falls concentrates on falls from stairs or from windows; there is no prevention guidance about falls from household furniture in children older than 6

months.<sup>2</sup> A study by Agran et al.<sup>3</sup> examining rates of pediatric injuries by 3-month intervals for children ages 0 year to 3 years found that falls from furniture were the second leading cause of injury in children beginning at 3 months until 47 months. In this study, peak falls from furniture occurred at ages 6 months to 8 months and 15 months to 17 months. Falls from stairs, however, were significantly less in all age groups than those from furniture and peaked at 6 months to 8 months and 9 months to 11 months.

Studies have examined the correlation of injury occurrence and physician anticipatory guidance. A study by Ruddy et al.<sup>4</sup> examined pediatrician anticipatory guidance for falls by administering a survey to physicians. Results showed that only 40% of pediatricians were giving adequate guidance about household furniture safety, a significantly lower value than the 90% who were touching on other injury hazards such as poisoning and automobile safety. Anticipatory guidance by physicians is important because it can reduce injuries. A study by Hall et al.<sup>5</sup> examining mortality caused by falls of less than 3 feet in children 1 year to 4 years found that proper anticipatory guidance and parental education could have prevented many lethal accidents.

The purpose of this study was to compare the number of children injured, ages of injured children, and injuries sustained in falls from furniture with falls from stairs in hospitalized children less than 5 years.

Submitted: December 22, 2011, Revised: May 15, 2012, Accepted: May 20, 2012.  
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This study was presented as a poster presentation at the Pediatric Academic Societies' Annual Meeting, April 30–May 3, 2011, in Denver, Colorado.

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DOI: 10.1097/TA.0b013e31826b017c

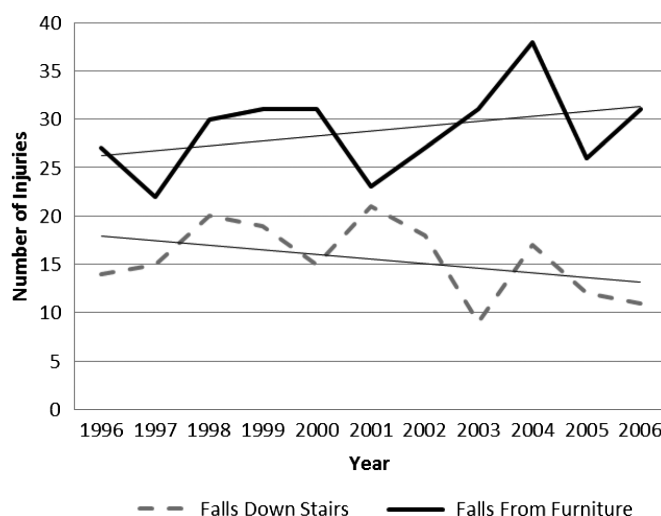
## PATIENTS AND METHODS

A retrospective study was performed. All medical records of individuals from birth through 4 years who were hospitalized at Cincinnati Children's Hospital Medical Center (CCHMC) for a fall from furniture or from stairs between January 1, 1996, and December 31, 2006, were reviewed. CCHMC is a freestanding children's hospital and a Level I trauma center with an annual emergency department volume of approximately 95,000 visits. In 2006, 23% of children seen for injuries were hospitalized. Records were identified through the CCHMC Trauma Registry, an ongoing database established in 1991 that contains information about all patients sustaining injuries. The CCHMC trauma registry undergoes quality control measures monthly to ensure validity and reliability.

All patients from birth through 4 years who were hospitalized and fell off of an item of furniture or stairs were included. Patients who were in an infant carrier that was placed on furniture were also included. Patients were excluded if they fell onto or into furniture or stairs, had furniture fallen on them, or sustained falls other than from furniture or stairs (i.e., playground equipment, parent's arms, etc.). Patients who presented with injuries secondary to child abuse as determined by the child abuse team were also excluded.

A standard data set was abstracted from each chart including medical record number, address of residence, age at time of fall, race, sex, date of birth, medical history, where the injury occurred, furniture from which fall was sustained or number of steps fallen down, height of fall, normal or abnormal physical examination result, injuries incurred, Injury Severity Score (ISS), whether there was a loss of consciousness, admission status (intensive care unit or floor bed), body region(s) injured, length of stay, outcome (living or deceased), and total cost of medical treatment based on patient charges. In addition, whether the patient has a skeletal survey performed was noted; skeletal surveys are a series of x-ray studies performed to assess for occult injuries thought to be caused by child abuse. To maintain confidentiality, each patient was assigned an ID code before data analysis, and medical record numbers were not used.

From these data, we aimed to characterize the study population, identify risk factors for childhood falls from fur-



**Figure 1.** Number of children hospitalized with injuries caused by falls from stairs and falls from furniture by year.

niture and stairs in individuals aged 0 years through 4 years, and determine the cost of medical treatment per hospital admission for treating an injury secondary to a fall from furniture compared with a fall from stairs. Frequencies and descriptive statistics were used to characterize the study population.  $\chi^2$  and Fisher's exact tests were used to determine differences between the furniture falls group and the stair falls group for categorical variables, and Student's *t* test was used to determine differences between groups for continuous variables.  $\chi^2$  for trend was used to determine if there were differences in trends in the numbers of falls between the two groups during the study period. The data were analyzed using IBM SPSS Statistics for Windows, Version 19 (IBM Corp, Armonk, NY) and Statistical Analysis System, Version 9.3 (SAS Institute, Inc., Cary, NC).

## RESULTS

During the study period, 171 patients were hospitalized for falls from stairs and 318 for falls from furniture. The mean age of children who fell from furniture was 24.9 months and for children who fell from stairs was 27.9 months. There were no differences between the groups with regard to age, sex, race, type of insurance as seen in Table 1. The total hospital cost was documented for 164 of the patients (95.9%) hospitalized for falls from stairs and 304 of the patients (95.6%) that fell from furniture.

Of the children who fell from stairs for which number of stairs fallen down was known, 75% fell from 5 or more stairs. The number of stairs fallen from was not documented in 49 children (28.7%). The most common pieces of furniture children fell from were beds (33.0%), couches (18.9%), chairs (17.9%), tables (9.7%), and bunk beds (6.9%).

Figure 1 depicts the number of hospitalizations per year for falls from stairs compared with falls from furniture. Falls from stairs shows downward trend, while falls from furniture shows an upward trend during the study period; however, there was no significant difference in trends for falls from furniture, from stairs, or between the two groups ( $p = 0.09$ ).

**TABLE 1.** Demographics of the Study Population\*

	All Patients (N = 489)	Stair Falls (n = 171)	Furniture Falls (n = 318)
Age, mean (SD), mo	26.0 (16.8)	27.9 (16.0)	24.9 (17.2)
Race			
White, n (%)	349 (71.4)	132 (77.2)	217 (68.2)
Black, n (%)	97 (19.8)	27 (15.8)	70 (22.0)
Other, n (%)	43 (8.8)	12 (7.0)	31 (9.7)
Male sex, n (%)	275 (56.2)	102 (59.6)	173 (54.4)
Insurance type			
Commercial/HMO, n (%)	275 (56.2)	106 (62)	169 (53.1)
Medicaid/welfare, n (%)	176 (36.0)	54 (31.6)	122 (38.4)
Other/unknown, n (%)	38 (7.8)	11 (6.4)	27 (8.5)

\*No significant differences between stair falls and furniture falls with regard to mean age, sex, race, or type of insurance.

**TABLE 2.** Clinical, Treatment, Disposition, and Cost Characteristics of Study Patients

	All Patients (N = 489)	Stair Falls (n = 171)	Furniture Falls (n = 318)
Documented loss of consciousness, n (%) <sup>*</sup>	35 (7.2)	22 (12.9)	13 (4.1)
Skeletal survey performed, n (%) <sup>*</sup>	82 (16.8)	16 (9.4)	66 (20.8)
Where admitted			
Floor, n (%)	438 (91.6)	152 (91.0)	286 (92.0)
Intensive care unit, n (%)	17 (3.6)	8 (4.8)	9 (2.9)
Operating room, n (%)	23 (4.8)	7 (4.2)	16 (5.1)
Length of stay, mean (SD), d	1.4 (1.2)	1.3 (0.8)	1.4 (1.3)
ISS, mean (SD)	6.0 (4.1)	6.4 (4.4)	5.8 (4.0)
Total cost, mean (SD), \$	2,663 (3,037)	2,760 (3,776)	2,610 (2,555)

<sup>\*</sup>Significant difference between stair falls and furniture falls ( $p < 0.001$ ).

Significantly more children who fell from stairs than those that fell from furniture had a loss of consciousness (12.9% vs. 4.1%,  $p < 0.001$ ) as shown in Table 2. Skeletal surveys were more commonly obtained in those falling from furniture than those falling from stairs (20.8% vs. 9.7%,  $p = 0.001$ ). There were no differences between the groups with regard to whether they went to the intensive care unit or operating room, length of stay, ISS, or total hospital cost per individual patient.

Of all the patients, 53 (10.8%) sustained injuries to more than one body region. There was a significant difference between the groups: 19.3% (33) in the group that fell from stairs versus 6.3% (20) in the group that fell from furniture ( $p < 0.001$ ). Children who fell from stairs were significantly more likely to have injuries to their head (64.3% vs. 38.1%); those that fell from furniture were more likely to sustain arm injuries (33.3% vs. 9.9%) (Table 3). There were more skull fractures in those that fell from stairs (39.8% vs. 20.1%) and more humerus fractures in those that fell from furniture (30.8% vs. 9.4%) (Table 4). These injuries were significantly different ( $p < 0.001$ ).

## DISCUSSION

Falls are common in children and can result in hospitalization with significant injuries. Falls from furniture and falls from stairs are two important causes of fall-related injuries.

**TABLE 3.** Primary Body Region Injured

	All Patients (N = 489)	Stair Falls (n = 171)	Furniture Falls (n = 318)	OR (95% CI) Stair vs. Furniture Falls
Head <sup>*</sup>	231 (47.2)	110 (64.3)	121 (38.1)	2.9 (2.0, 4.3)
Arm <sup>*</sup>	123 (25.2)	17 (9.9)	106 (33.3)	0.22 (0.12–0.38)
Leg	108 (22.1)	37 (21.6)	71 (22.3)	0.96 (0.61–1.5)
Face	15 (3.1)	6 (3.5)	9 (2.8)	1.2 (0.43–3.6)
Other	12 (2.4)	1 (0.6)	11 (3.5)	0.16 (0.02–1.3)

<sup>\*</sup>Significant difference ( $p < 0.001$ ).  
CI, confidence interval; OR, odds ratio.

**TABLE 4.** Primary Injury Type

	All Patients (N = 489)	Stair Falls (n = 171)	Furniture Falls (n = 318)	OR (95% CI) Stair vs. Furniture Falls
Concussion/intracranial bleed, n (%)	66 (13.5)	27 (15.8)	39 (12.3)	1.3 (0.79, 2.3)
Femur fracture, n (%)	104 (21.3)	35 (20.5)	69 (21.7)	0.93 (0.59, 1.5)
Humerus fracture, n (%) <sup>*</sup>	114 (23.3)	16 (9.4)	98 (30.8)	0.23 (0.13, 0.41)
Skull fracture, n (%) <sup>*</sup>	132 (27.0)	68 (39.8)	64 (20.1)	2.62 (1.7, 4.0)
Other, n (%)	73 (14.9)	25 (14.6)	48 (15.1)	0.96 (0.57, 1.6)

<sup>\*</sup>Significant difference  $p < 0.001$ .

This study found that 1.8 times more children were hospitalized for falls from furniture than falls from stairs. This is similar to other studies that have shown that falls from furniture are more common than falls from stairs in children younger than 5 years.<sup>3,6</sup> The information presented in this study is important because guidance recommended by American Academy of Pediatrics addresses falls from stairs to age 5 years yet only addresses falls from furniture through 6 months of age.<sup>2</sup> Many providers know of the importance of falls from stairs but may not be aware of the significant impact of injuries caused by the falls from furniture, especially in somewhat older children. Prevention of these injuries could significantly reduce health care costs. Anticipatory guidance materials addressing falls from furniture need to be developed for children older than 6 months to educate providers and families about these injury patterns.

The number of children hospitalized for falls from stairs decreased throughout the study period, while those for falls from furniture increased, although the trends were not statistically significant. The trend for decreased stair-related injuries may be caused by increased anticipatory guidance, decreased use of walkers, or increased use of stair gates in recent years.<sup>7–10</sup> The reason for the trend for increased falls from furniture is unclear but may be caused by lack of awareness of the impact of these injuries or lack of anticipatory guidance materials and provision to families as mentioned previously.

In this study, there were no significant differences in children who were hospitalized for falls from stairs compared with falls from furniture with regard to age, sex, race, and insurance type. Significant hospital costs were incurred from these injuries.

Children who fell from stairs had more head injuries, while children who fell from furniture had more upper-extremity injuries. This is consistent with other studies where falling from furniture results in mostly upper-extremity injuries, particularly fractures,<sup>11</sup> while falling from stairs results in more head injuries.<sup>12,13</sup> In addition, children who fell from stairs were more likely to have more than one injured body region. This is likely caused by the injury mechanisms: falls from furniture are direct vertical falls, while falls from stairs are a series of smaller falls but usually over greater collective distances. Similar to other studies, the most common pieces of furniture that children fall from were beds, couches, and chairs.<sup>6,11,14,15</sup>

Children who fell from furniture were more likely to get skeletal surveys than those that fell from stairs. It is unclear from our data whether this is because fewer were directly witnessed, the severity of injury was greater than practitioners expected, or the histories were less believable. Other studies have shown that short vertical falls usually do not result in severe injuries, which may influence practitioner's decisions to suspect child abuse.<sup>14,16,17</sup>

This study had several limitations. This study was retrospective, making it susceptible to missing data. The only data that were commonly not documented was the number of stairs fallen from. All other reported data points had less than 5% missing data and therefore were likely an accurate representation of the population. Another limitation was that only hospitalized patients were studied. This was done to examine the more severe injuries. This study is not generalizable to nonhospitalized patients. In addition, all patients were from a single hospital, which may not be generalizable to other institutions or settings.

This study found that nearly twice as many children were hospitalized for falls from furniture compared with falls from stairs. The number of children hospitalized for falls from stairs has been decreasing, while those for falls from furniture have been increasing. Anticipatory guidance should be changed to include falls from furniture up to age 5 years.

#### AUTHORSHIP

W.J.P. contributed to all aspects of this article including literature search, study design, data collection, data analysis, data interpretation, writing, tables, and figures and to the approval of the final version. M.A.G. contributed to the literature search, study design, data collection, data interpretation, writing, tables, and figures and to the approval of the final version. R.H. contributed to study design, data interpretation, writing, tables, and figures and to the approval of the final version. H.H. contributed to the literature search, study design, data collection, writing, tables, and figures and to the approval of the final version.

#### ACKNOWLEDGMENTS

We would like to thank Margie Koehn, coordinator of the Cincinnati Children's Hospital Trauma Registry, and the Division of Trauma Services for the data to perform this study.

#### DISCLOSURE

The authors declare no conflicts of interest.

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