

Pediatric Unintentional Fall-Related Injuries in a Statewide Trauma Registry

Jonathan Davis, PhD,† Tracy Young, MS,* Carri Casteel, PhD,†
Corinne Peek-Asa, PhD,† and James Torner, PhD‡

Objectives: The purpose of the study was to evaluate patterns of fall-related injury through childhood and identify risk factors for more severe fall-related injuries with the goal of informing targeted prevention strategies for different ages.

Methods: The study population consisted of pediatric patients in the Iowa Trauma Registry from January 1, 2010, to December 31, 2014, who sustained an unintentional fall-related injury (N = 3856 patients). Multinomial logistic regression analysis was used to predict injury severity. Adjusted odds ratios were calculated characterizing the relationship between fall severity and age, sex, race, and fall type.

Results: More males (62%) sustained a fall-related injury during the study period when compared with females (38%; $P < 0.0001$). Head injuries were the most common type of injury in the younger than 1 year age group (77%), whereas fractures were the predominant injury type in all other age groups, followed by head injuries. Those younger than 1 year (adjusted odds ratio, 4.0; 95% confidence interval, 2.36–6.90) and aged 15 to 18 years (adjusted odds ratio, 1.9; 95% confidence interval, 1.17–3.03) were more likely to have an Injury Severity Score of ≥ 16 than those aged 10 to 14 years.

Conclusions: Recommendations and prevention strategies need to focus on specific risk factors to reduce the harm of multilevel falls. As we have shown, patterns of fall injuries presenting to trauma hospitals differ by age, thus suggesting that prevention strategies focus on specific age groups.

Key Words: fall-related injuries, fall type, fall level, prevention strategies

(*Pediatr Emer Care* 2022;38: e961–e966)

Unintentional falls are the leading cause of nonfatal injuries among children aged 0 to 9 years and the second leading cause of nonfatal injury in children and young adults aged 10 to 24 years.¹ Overall, falls account for 8.8% of all pediatric emergency department visits.² Previous studies indicate that the leading causes of falls differ by age.³ Falls among infants and young children have been extensively studied, with several risk factors for falls identified such as sex, height of the fall, whether the child was dropped, and if the fall occurred at home.⁴ Fall-related injuries among infants and toddlers are commonly caused by slipping from caregiver's arms^{3,5} or falling from furniture^{2,3,5,6} and more frequently result in head injuries.^{5,7} Playground injuries become more common among elementary school-aged children with the

highest frequency occurring around age of 6 years^{2,3}; previous research has also shown that height^{8,9} and surface type⁹ are important predictors of severe injury among elementary school-aged children.

Although infants and toddlers have been extensively studied, less information exists for school-aged children, despite the risk for fall-related injuries persisting throughout childhood. Our study differs from much of the unintentional pediatric fall-related literature in that we evaluated patterns of fall-related injury through the age of 18 years and identified risk factors for more severe fall-related injuries. To accomplish this goal, we used a statewide trauma database, the Iowa Trauma Registry (ITR), which provides a comprehensive surveillance system of traumatically injured patients. This age-specific information is essential to provide recommendations and identify prevention strategies for various childhood age groups.

METHODS

Study Design and Population

This was a retrospective study using 2010 to 2014 ITR data, which were collected through the Iowa Trauma System. Iowa hospitals are categorized at their level of trauma care following guidelines from the American College of Surgeons.¹⁰ Level I trauma care facilities (TCFs) are verified by the American College of Surgeons Committee on Trauma, and levels II to IV TCFs are verified by the Iowa Trauma System. The Iowa Trauma System is consisted of 118 acute care hospitals in Iowa, including 2 level I, 4 level II, 20 level III, and 92 level IV TCFs. All levels I to III TCFs and approximately one half of the level IV TCFs submitted data to the trauma registry during the 2010 to 2014 study period. Level I hospitals provide the highest level of care and provide leadership in education, research, and system planning. Level II hospitals provide the highest level of care but are not required to have the same research and education activities as level I centers. Level III hospitals have the resources to provide stabilization for all trauma patients and may provide surgical and/or critical care. Level IV hospitals provide initial evaluation, stabilization, and diagnostic capabilities and may provide some surgical care. The Iowa Trauma System mandates that all level I through level III hospitals provide data to the ITR. During the study period, level IV TCFs voluntarily submitted data to the trauma registry.

Patients included in the trauma registry had at least 1 *International Classification of Diseases, Ninth Revision, Clinical Modification* injury diagnosis code between 800.00 and 959.9, excluding 905 to 909 (late effects of injuries), 910 to 924 (blisters, contusions, abrasions, and insect bites), 930 to 939 (foreign bodies), and isolated hip fractures resulting from a same level fall unrelated to a traumatic event. In addition, the patient had to meet 1 of 2 conditions: admission to a hospital, transferred to a hospital, or died in the hospital; or the hospital trauma team was activated.

For the registry, trauma nurses/registrars at each hospital abstract data from medical records within 90 days of the injury and enter it into the registry using the software COLLECTOR (Copyright

From the *Injury Prevention Research Center; and †Departments of Occupational and Environmental Health, and ‡Epidemiology, College of Public Health, University of Iowa, Iowa City, IA.

Disclosure: J.D., T.Y., C.C., C.P.-A., and J.T. report grants from the CDC National Center for Injury Prevention and Control, during the conduct of the study.

Reprints: Jonathan Davis, PhD, Injury Prevention Research Center, University of Iowa, 2195 Westlawn, Iowa City, IA 52242-5000 (e-mail: jonathan-a-davis@uiowa.edu).

This work was supported by the University of Iowa Injury Prevention Research Center, funded by the CDC National Center for Injury Prevention and Control (R49CE002108).

Copyright © 2021 Wolters Kluwer Health, Inc. All rights reserved.
ISSN: 0749-5161

2001, System Trauma Registry, Digital Innovations, Inc.). Data are submitted by each hospital to the State Trauma System Coordinator at the Iowa Department of Public Health.

Unintentional falls are defined within the ITR as any patient with an *International Classification of Diseases, Ninth Revision, Clinical Modification* external cause of injury code of E880 to E886 and E888. E-codes were missing for 331 patients (0.5%) in the ITR. Of the 72,580 patients in the trauma registry from 2010 to 2014, a total of 34,549 patients who met the criteria for being a fall injury were identified. We restricted our analysis to the pediatric population (ages younger than 19 years), which resulted in 4119 patients. We excluded 263 fall-related cases because of missing Injury Severity Scores (ISSs), resulting in 3856 patients from 2010 to 2014. The number of fall patients seen at each level of hospital included 1051 level I (27.3%), 1272 level II (33.0%), 1175 level III (30.5%), and 354 level IV (9.2%), and there were 4 that were fall related but missing a valid hospital ID.

Variables

We focused on eight variables in our analysis: age, sex, race, general, and more detailed etiology of fall type, primary insurance status, primary nature of injury, and ISS (based on direct Abbreviated Injury Scale severity coding). From mechanism of injury, we created variables for general fall type and more detailed fall type. General fall type was classified as multilevel (ladders/scaffolding, E881; building/other structure, E882; hole/other opening, E883; other fall from one level to another, E884), same level (E885, E886), stairs/steps (E880), and other/unspecified (E888). The more detailed fall type was classified as stairs/steps (E880/.0, .1, .9; includes escalator, fall on or from sidewalk/curb, and other stairs/steps), ladder/scaffolding (E881/.0, .1), building/other structure (E882), hole/other opening (E883/.1, .2, .9; includes fall into well, fall into storm drain/manhole, other hole/opening), other different level (E884/.0, .1, .2, .3, .4, .5, .6, .9; includes playground equipment, cliff, chair, wheelchair, bed, other furniture, commode, and other — .9 tree, haystack, embankment, stationary vehicle, fell from parent's/sibling's arms, fell out of car seat), slipping/tripping/stumbling (E885/.0, .1, .2, .3, .4, .9; includes nonmotorized scooters, roller skates, skateboard, skis, snowboard, and other slipping/tripping/stumbling), collision/pushing/shoving by or with other person (E886/.0, .9; includes in sports and other/unspecified), and other/unspecified fall (E888/.0, .1, .8, .9; includes striking against sharp object due to falling, striking against other object due to falling, other fall, and unspecified fall).

Statistical Analysis

Age patterns were examined by demographic, injury event, injury type, and severity characteristics and statistically evaluated for differences using χ^2 tests. We performed a multinomial logistic regression analysis to predict injury severity. Adjusted odds ratios and 95% confidence intervals (CIs) were calculated characterizing the relationship between predictors: age, sex, race, and general fall type (multilevel, stairs/steps, other/unspecified vs same level). Data analyses were performed using SAS 9.4 (SAS Institute, Inc., Cary, NC).

RESULTS

Population Description

Our study population included 3856 pediatric patients who were admitted to an Iowa TCF because of a fall-related injury, of whom 8 (0.2%) died. The proportion of falls in this population

remained relatively steady over the 5-year period at approximately 19% with a slight spike in 2012 with 22%.

Overall, more males (62%) sustained a fall-related injury during the study period when compared with females (38%, Table 1; $P < 0.0001$). The majority (85%) of pediatric falls were among children who were White, which is somewhat lower than the Iowa population, of which 91.3% is White. Medicaid was the main primary insurance source in those younger than 5 years followed by commercial insurance. Commercial insurance was the most common payer source in those aged 5 to 18 years.

Nearly 54% were multilevel falls. Multilevel falls were more common in those younger than 10 years, whereas same level falls were more common in the 10- to 14-year and 15- to 18-year age groups ($P < 0.0001$). Head injuries were the most common type of injury in the younger than 1 year age group (77%). Fractures were the predominant injury type (60%) in all other age groups with head injuries (21%) being the second most common. Mild ISSs (1–8) were most common across all age groups, whereas those younger than 1 years had the highest proportion of severe ISSs (≥ 16 , 21%) compared with the other age groups that ranged from 3% to 9% ($P < 0.0001$).

Fall Type and Etiology

Different level falls (multilevel falls, E881–E884; stairs/steps, E880) were the most frequent type of fall-related injury for children under the age of 10 years (Table 2). The type of different level fall varied across age groups. For children under the age of 1 year, falls were most frequently classified as other (E884.9, 36.2%; for example, falls from parent's/sibling's arms, countertop, changing table, shopping cart, car seat). Fall from furniture (25.3%, includes chair, bed, and other furniture types) and stairs/steps (16.2%) were also common types of fall in children younger than 1 year (Table 2). Falls for children aged 1 to 4 years most often occurred from furniture (19.0%), playground equipment (12.8%), and other multilevel (17.9%) (eg, tree, embankment, haystack, stationary vehicle). Those aged 5 to 9 years fell most frequently from playground equipment (39.6%) and were the most likely age group to fall from playground equipment. Ages 10 to 14 years fell most often because of slipping/tripping (36.9%) falls. Those aged 15 to 18 years fell more often because of slipping/tripping (30.7%) and colliding/pushing/shoving (22.0%).

Multinomial Logistic Regression Model Predicting Injury Severity

In the multinomial logistic regression model predicting ISS, compared with ISS of <9 , multilevel falls were significantly more likely to have an ISS of 9 to 15 than those falling from the same level (adjusted odds ratio [aOR], 1.3; 95% CI, 1.06–1.55; Table 3). Compared with ISS of <9 , those younger than 1 year (aOR, 4.0; 95% CI, 2.36–6.90) and aged 15 to 18 years (aOR, 1.9; 95% CI, 1.17–3.03) were more likely to have an ISS of ≥ 16 (severe) than those aged 10 to 14 years. Compared with the ISS of <9 , those who fell from stairs/steps (aOR, 2.0; 95% CI, 1.17–3.55) and multilevels (aOR, 1.5; 95% CI, 1.04–2.24) were more likely to have an ISS of ≥ 16 than those who fell from the same level.

DISCUSSION

Our study provides a detailed analysis of pediatric fall-related injuries using statewide trauma registry data. We described how falls differ across age groups and identified what types of falls were more likely to lead to serious injury. Similar to a previous study using the Nationwide Emergency Department Sample, we found a greater proportion of pediatric falls were male.² Being male has also been previously identified as a risk factor for

TABLE 1. Demographics, Mechanism, Primary Nature of Injury, Severity, and Primary Payer

Variables	<1 y		1–4 y		5–9 y		10–14 y		15–18 y		Total		P
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	
Sex													<0.0001
Male	142	(62.0)	608	(61.0)	735	(56.3)	529	(66.6)	380	(71.6)	2394	(62.1)	
Female	87	(38.0)	389	(39.0)	570	(43.7)	265	(33.4)	151	(28.4)	1462	(37.9)	
Race													<0.0001
White	168	(83.6)	730	(80.8)	1027	(85.7)	608	(87.2)	437	(91.4)	2970	(85.4)	
Black	15	(7.5)	39	(4.3)	48	(4.0)	38	(5.5)	15	(3.1)	155	(4.5)	
Other	18	(9.0)	135	(14.9)	123	(10.3)	51	(7.3)	26	(5.4)	353	(10.1)	
General type of fall													<0.0001
Multilevel	146	(63.8)	591	(59.3)	904	(69.3)	271	(34.1)	150	(28.2)	2062	(53.5)	
Same level	15	(6.6)	164	(16.4)	263	(20.2)	411	(51.8)	280	(52.7)	1133	(29.4)	
Stairs/steps	37	(16.2)	132	(13.2)	35	(2.7)	19	(2.4)	37	(7.0)	260	(6.7)	
Other/unspecified	31	(13.5)	110	(11.0)	103	(7.9)	93	(11.7)	64	(12.1)	401	(10.4)	
Primary nature of injury													<0.0001
Any fracture	33	(14.9)	494	(50.5)	1000	(77.0)	539	(68.8)	222	(42.3)	2288	(60.1)	
Dislocation/sprain	*	*	12	(1.2)	22	(1.7)	31	(4.0)	39	(7.4)	105	(2.8)	
Head injury	171	(77.0)	298	(30.4)	177	(13.6)	125	(16.0)	158	(30.1)	929	(24.4)	
Internal organ/blood vessel	*	*	17	(1.7)	18	(1.4)	23	(2.9)	26	(5.0)	86	(2.3)	
Open wound	*	*	105	(10.7)	48	(3.7)	26	(3.3)	22	(4.2)	206	(5.4)	
Other injury	10	(4.5)	52	(5.3)	26	(2.0)	16	(2.0)	22	(4.2)	126	(3.3)	
SCI and/or VCI	0	(0.0)	*	*	7	(0.5)	23	(2.9)	36	(6.9)	67	(1.8)	
ISS													<0.0001
1–8	126	(55.0)	700	(70.2)	809	(62.0)	509	(64.1)	374	(70.4)	2518	(65.3)	
9–15	55	(24.0)	243	(24.4)	457	(35.0)	252	(31.7)	109	(20.5)	1116	(28.9)	
≥16	48	(21.0)	54	(5.4)	39	(3.0)	33	(4.2)	48	(9.0)	222	(5.8)	
Primary insurance status [†]													<0.0001
Commercial	58	(31.4)	282	(35.5)	463	(44.0)	324	(49.9)	245	(55.4)	1372	(43.9)	
Managed care	40	(21.6)	103	(13.0)	159	(15.1)	100	(15.4)	54	(12.2)	456	(14.6)	
Medicaid	73	(39.5)	326	(41.1)	316	(30.0)	150	(23.1)	92	(20.8)	957	(30.7)	
Other	12	(6.5)	44	(5.5)	74	(7.0)	43	(6.6)	25	(5.7)	198	(6.3)	
Uninsured	*	*	39	(4.9)	40	(3.8)	32	(4.9)	26	(5.9)	139	(4.5)	

*Data were suppressed because of cell sizes <6.

[†]Thirty-four patients missing payer information.

SCI indicates spinal cord injury; VCI, vertebral column injuries.

fall-related injury in children under the age of 7 years.⁴ These previous studies do not, however, evaluate injury severity. Injury severity of pediatric falls for children under the age of 5 years has been evaluated using Georgia's trauma system data.⁵ This previous study did not find male children to be at risk of more severe injury.⁵ We did identify a slight increase in the odds of more severe injury for male children, but this was not statistically significant. The difference in the 2 findings may be due to the inclusion of older children in our study or because we controlled for fall type in our model.

We found that etiology of the fall-related injury varied by age group. For children under 1 year, injuries were a result of falling from one level to another (other one level to another, E884). This occurred from being dropped by a caregiver or sibling or falling off a surface such as a counter or furniture. Falling off furniture was the main driver of fall-related injury for children 1 to 4 years old with some indication of playground related injuries, which were most common for children aged 5 to 9 years. Finally, after age of 10 years, slipping and shoving were the most common ways a child was injured from a fall. These differences match general trends described in the Nationwide Emergency Department

Sample.² A previous study of consumer products involved in fall injuries found beds to be the most common product contributing to a fall-related injury for children under the age of 5 years, monkey bars for children aged 5 to 9 years, and stairs for children 10 years and older.¹¹ These products contributing to injuries for each age group is consistent with the type of falls identified for each age group in our study. For children under the age of 4 years, a previous study found no difference in the type of fall and injury severity.⁵ We found that falls from multilevel or stairs and steps were more likely to result in an injury severity of greater than 16. Preventing these types of injuries will reduce the number of severe pediatric injuries from falling.

Minor injuries were more common for children over the age of 1 year. This is similar to a study of pediatric patients who experienced an injury from a fall in a study of a level I pediatric trauma registry.³ The difference in the types of falls experienced by the youngest and older age groups may partially explain the higher proportion of less severe injuries in older children. When fall type was controlled for, the oldest (15–18 years) and youngest (<1 year) age groups were most likely to experience the most severe injury. Whereas the youngest children were the most likely to be severely

TABLE 2. Detailed Type of Fall by Age

Detailed Fall Type	<1 y		1–4 y		5–9 y		10–14 y		15–18 y		Total	
	n	(%)*	n	(%)*	n	(%)*	n	(%)*	n	(%)*	n	(%)*
Different level falls												
Stairs/steps (E880)	37	(16.2)	132	(13.2)	35	(2.7)	19	(2.4)	37	(7.0)	260	(6.7)
Ladders/scaffolding (E881)	‡	‡	13	(1.3)	12	(0.9)	9	(1.1)	15	(2.8)	50	(1.3)
Building/other structure (E882)	0	(0.0)	78	(7.8)	38	(2.9)	20	(2.5)	23	(4.3)	159	(4.1)
Hole/other opening (E883)	0	(0.0)	‡	‡	‡	‡	‡	‡	8	(1.5)	21	(0.5)
Other one level to another (E884)	145	(63.3)	495	(49.6)	850	(65.1)	238	(30.0)	104	(19.6)	1832	(47.5)
Playground equipment (.0)*	‡	‡	128	(12.8)	517	(39.6)	82	(10.3)	16	(3.0)	747	(19.4)
Furniture (.2, .4, .5)*	58	(25.3)	189	(19.0)	80	(6.1)	14	(1.8)	8	(1.5)	349	(9.1)
Other (.9)*†	83	(36.2)	178	(17.9)	253	(19.4)	142	(17.9)	80	(15.1)	736	(19.1)
Total	182	(79.5)	723	(72.5)	939	(72.0)	290	(36.5)	187	(35.2)	2322	(60.2)
Same level falls												
Slip/trip/stumble (E885)	14	(6.1)	150	(15.0)	211	(16.2)	293	(36.9)	163	(30.7)	831	(21.6)
Collide/push/shove (E886)	‡	‡	14	(1.4)	52	(4.0)	118	(14.9)	117	(22.0)	302	(7.8)
Total	15	(6.5)	164	(16.4)	263	(20.2)	411	(51.8)	280	(52.7)	1133	(29.4)
Other/unspecified falls (E888)	31	(13.5)	110	(11.0)	103	(7.9)	93	(11.7)	64	(12.1)	401	(10.4)
Overall total	229	(5.9)	997	(25.9)	1305	(33.8)	794	(20.6)	531	(13.8)	3856	

*Percent based on overall totals across each age group.

†No patient had an external cause code = E884 (.1, .3, .6).

‡Data were suppressed because of cell sizes <6.

injured, older age groups should not be ignored in efforts to prevent fall-related injuries. Children aged 15 to 18 years were more likely to have an injury resulting from a fall from stairs or steps or from a building or other structure compared with children aged 5 to 9 years and 10 to 14 years. Efforts to prevent these types of injuries may lower the injury disparity observed for the oldest age group.

In addition, children have different types of injuries based on their age. Those under the age of 1 year were most likely to have head injuries. This transitioned to fracture-related injuries being the most common type of injury for all other age groups. This trend mirrors the experience of children in the Nationwide Emergency Department Sample.²

TABLE 3. Multinomial Logistic Regression of Demographic and General Fall Type Characteristics and Their Association With Moderate and Severe Injury Severity (N = 3856)

Covariates	ISS 9–15 vs 1–8 (Referent)			ISS ≥16 vs 1–8 (Referent)		
	n	aOR*	95% CI	n	aOR*	95% CI
Age						
<1 y	55	0.84	0.57–1.23	48	4.04	2.36–6.90
1–4 y	243	0.63	0.50–0.80	54	0.88	0.54–1.43
5–9 y	457	1.01	0.82–1.25	39	0.58	0.35–0.97
10–14 y	252	Ref	—	33	Ref	—
15–18 y	109	0.61	0.46–0.81	48	1.88	1.17–3.03
Sex						
Male	669	0.94	0.81–1.10	151	1.25	0.92–1.72
Female	447	Ref	—	71	Ref	—
Race						
White	852	Ref	—	169	Ref	—
Black	43	0.98	0.68–1.41	10	1.09	0.55–2.15
Other	106	1.09	0.85–1.40	25	1.41	0.90–2.22
General type of fall						
Multilevel	658	1.28	1.06–1.55	123	1.52	1.04–2.24
Same level	313	Ref	—	53	Ref	—
Stairs/steps	61	1.07	0.75–1.52	26	2.04	1.17–3.55
Other/unspecified	84	0.65	0.47–0.88	20	1.07	0.61–1.86

*Model controlling for age, sex, race, and general fall type.

Ref indicates reference level.

In a review of risk factors for pediatric falls in children under 7 years old, low socioeconomic status was identified as a risk factor for fall-related injury.⁴ A population-based study of 2 Ontario hospitals found that areas where 40% of households were at or above the poverty line had higher-rate ratios of fall-related injuries for residents aged 0 to 19 years, as well as home injuries, recreation injuries, and traffic injuries, compared with areas where 0% to 9% of the households fell below the poverty line.¹² We did not specifically analyze socioeconomic status in our analysis. We did, however, include insurance payer source, which can serve as a surrogate for socioeconomic status with higher socioeconomic status individuals expected to have commercial insurance and lower socioeconomic status individuals having Medicaid as a payer source. We found that the most common payer type for children under 5 years old was Medicaid. This is similar to the study using Georgia's trauma system where the authors used payer type as a proxy for socioeconomic status.⁵ However, we found a shift in pay type after the age of 5 years when commercial insurance became the most common payer type for pediatric fall-related injuries. Payer type may not be an adequate surrogate for socioeconomic status because enrollment in Medicaid enrollment increases before giving birth.¹³ Instead, it may reflect the employment status of the parent. The increase in commercial insurance after the age of 5 years signifies a return to work for parents of young children or an increase in income for the parent over time. In either case, socioeconomic status alone is difficult to distinguish from the additional changes that come from returning to work or transitioning to a different payer source for insurance. For this reason, socioeconomic status alone may not be a risk factor for pediatric fall-related injury.

The statewide trauma registry provides uniform data with a multitude of elements for analysis. Despite the strengths of trauma registry data, there are limitations that come from its use. The limitations of this study relate to the population studied and depth of coding. The trauma system includes patients seen in trauma hospitals that met trauma criteria and, therefore, represents only the more severe injuries or certain types of injuries needing higher levels of care (eg, complicated fractures, all levels of head injuries). The experience of children seen in the emergency department only or seen at a level IV TCF that did not submit data to the ITR during the study period will not be reflected in the registry data. Use of external cause of injury coding to identify fall-related injuries may lead to an underestimate of the number of fall-related injuries.¹⁴ However, the consistent application of fall codes will allow for identification of risk factors for a fall when using the data. In addition, we are limited to the information collected in the trauma system and lack narrative information about the fall that may allow for a deeper understanding of the mechanism behind each fall. We did not have information on all related risk factors, such as information on medications used at the time of the fall, but medication use would be of higher concern for older populations who are more likely to be on medications that increase the risk for a fall. Despite this, we were able to identify important differences in fall-related injuries across various pediatric age groups.

Patterns of fall injuries presenting to trauma hospitals in Iowa differed by age. The type of fall injuries common for each age group must be considered in fall prevention efforts. For children under 1 year old, supervision to prevent falling from higher surfaces and care when holding the children are important to reduce fall-related injuries.⁵ Also, the time carrying infant on stairs should be limited (eg, wear a front carrier and keep hand on railing), proper footwear must be worn (eg, shoes with good traction or go barefoot), and the home must be safety proofed (eg, use stair gates, guardrails).¹⁵ In toddlers and young children, falls from playground equipment were common. The National Program for

Playground Safety recommends the following: improve adult supervision of children on playgrounds; educate the public about age-appropriate playground equipment; build playgrounds with surfaces, such as shredded rubber, wood chips, wood fiber, and sand, that reduce injuries related to falls; and improve maintenance of equipment and surfacing.¹⁶ In addition, as in those younger than 1 year, supervision is important when it comes to falls from higher surfaces and keeping homes safe (eg, stair gates, guardrails, keep clutter off stairs, install lower stair rails, install safety rails on beds). For teenagers, to prevent slipping/tripping falls, keep area rugs secure, wear properly fitted and slip-resistant footwear (eg, tennis shoes), and keep clutter off the floor/hallways/stairs. Although rare, falls from structures can cause severe injuries. Older teenagers should exercise caution when on structures, especially when protective barriers are not present. For shoving/pushing/colliding falls, as well as same level falls, use uniform safety practices among participants in sports/recreational activities in the recreational/home/school-based setting and have efficient adult supervision during these types of activities.¹⁷ Recommendations and prevention strategies need to focus on specific risk factors and etiology. As we have shown, patterns of fall injuries presenting to trauma hospitals differ by age, thus suggesting that prevention strategies focus on specific age groups.

ACKNOWLEDGMENTS

The authors would like to thank all the TCFs in Iowa that collected data for the trauma registry. In addition, we would like to thank the Iowa Department of Public Health, Bureau of EMS for the use of the trauma registry data.

REFERENCES

- Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System (WISQARS; 2005). Available at: <http://www.cdc.gov/injury/wisqars>. Accessed June 1, 2019.
- Wang D, Zhao W, Wheeler K, et al. Unintentional fall injuries among US children: a study based on the National Emergency Department Sample. *Int J Inj Contr Saf Promot*. 2013;20:27–35.
- Unni P, Locklair MR, Morrow SE, et al. Age variability in pediatric injuries from falls. *Am J Emerg Med*. 2012;30:1457–1460.
- Khambalia A, Joshi P, Brussoni M, et al. Risk factors for unintentional injuries due to falls in children aged 0–6 years: a systematic review. *Inj Prev*. 2006;12:378–381.
- Chaudhary S, Figueroa J, Shaikh S, et al. Pediatric falls ages 0–4: understanding demographics, mechanisms, and injury severities. *Inj Epidemiol*. 2018;5(Suppl 1):7.
- Haney SB, Starling SP, Heisler KW, et al. Characteristics of falls and risk of injury in children younger than 2 years. *Pediatr Emerg Care*. 2010; 26:914–918.
- Pitone ML, Attia MW. Patterns of injury associated with routine childhood falls. *Pediatr Emerg Care*. 2006;22:470–474.
- Macarthur C, Hu X, Wesson DE, et al. Risk factors for severe injuries associated with falls from playground equipment. *Accid Anal Prev*. 2000; 32:377–382.
- Chalmers DJ, Marshall SW, Langley JD, et al. Height and surfacing as risk factors for injury in falls from playground equipment: a case-control study. *Inj Prev*. 1996;2:98–104.
- American College of Surgeons. Resources for optimal care of the injured patient. 2014. Available at: <https://www.facs.org/quality-programs/trauma/tqpc/center-programs/vrc/resources>. Accessed June 1 2019.
- Ali B, Lawrence B, Miller T, et al. Consumer products contributing to fall injuries in children aged <1 to 19 years treated in US emergency

- departments, 2010 to 2013: an observational study. *Glob Pediatr Health*. 2019;6:2333794X18821941.
12. Faelker T, Pickett W, Brison RJ. Socioeconomic differences in childhood injury: a population based epidemiologic study in Ontario, Canada. *Inj Prev*. 2000;6:203–208.
13. D'Angelo DV, Le B, O'Neil ME, et al, Centers for Disease Control and Prevention (CDC). Patterns of health insurance coverage around the time of pregnancy among women with live-born infants—pregnancy risk assessment monitoring system, 29 states, 2009. *MMWR Surveill Summ*. 2015;64:1–19.
14. Waters TM, Chandler AM, Mion LC, et al. Use of International Classification of Diseases, Ninth Revision, Clinical Modification, codes to identify inpatient fall-related injuries. *J Am Geriatr Soc*. 2013;61:2186–2191.
15. Parents. Copyright 2019 Meredith Corporation. Available at: <https://www.parents.com/baby/safety/baby-safety-tips-dont-drop-the-baby>. Accessed June 11, 2019.
16. Centers for Disease Control and Prevention (CDC), National Center for Injury Prevention and Control. 2000. Available at: <https://www.cdc.gov/safechild/playground/index.html>. Accessed June 1, 2019.
17. Conn JM, Annett JL, Bossarte RM, et al. Non-fatal sports and recreational violent injuries among children and teenagers, United States, 2001–2003. *J Sci Med Sport*. 2006;9:479–489.