An Exploration of Emergency Department Visits for Home Unintentional Injuries Among Children With Autism Spectrum Disorder for Evidence to Modify Injury Prevention Guidelines

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Objectives: Current childhood injury prevention guidance is anchored by a child's age. For example, children are considered at high risk for falls at ages 4 years and less, and guidance for prevention focuses on these ages. However, these guidelines may not be adequate for children with autism spectrum disorders (ASD).

Methods: This retrospective chart review examined injury characteristics for children with ASD receiving treatment in a pediatric emergency department between 2014 and 2016. Bivariate statistics determined injury demographic correlates. Chart narratives were also coded using traditional content analysis to determine the mechanism that caused the home injury.

Results: The sample (27 cases) was mostly male (89%), Black (48%), with a mean age of 7.8 (SD, 4.9) years. The most common mechanism was a fall (44%), followed by self-injurious behavior (33%), and then burns (22%). All cases identified at least 1 mechanism contributing to the injury, in 2 cases, 2 items were mentioned. Of the 29 items identified, most involved a house feature that was not stairs (24%); some included stairs, furniture, or a combination of foreign object and grill (21%); and few identified food/beverage/liquid (11%).

Conclusions: Analyses suggest that unintentional home injury prevention for children with ASD may require prevention guidance extended through older ages.

Key Words: home injury prevention, autism spectrum disorder, chart review

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Unintentional injuries are the number one source of morbidity and mortality for all children and adolescents aged 1 to 19 in the United States.[1] In the general population, home injuries are highest among children who are younger (less than 5 years old), male, are part of lower-income families, live in substandard housing, and have parents with lower education.[2–5] A large proportion of unintentional childhood injuries occur in the home resulting from falls and burns.[6]

Falls result in 1.8 million pediatric emergency department (ED) visits and more than 10,000 childhood hospitalizations annually.[7] Falls are the leading cause of nonfatal injuries among 0- to 15-year-old children treated in EDs.[8] Falls down the stairs are highest among toddlers and small children, whereas falls out of windows are more common in older children and adolescents.[9,10]

House fires cause 75% of all deaths from fires and burns, and young children and children with disabilities are at elevated risk, particularly children who must rely on others for rescue.[11] Scald burns from hot liquids are a significant source of burn-related ED visits and hospitalizations for all children.[12,13] Tap water is responsible for about one fourth of all scald burns and is associated with more deaths and hospitalizations in children than any other liquid.[14]

In addition to the burden of injuries for all children, prior studies have found that injuries disproportionately affect children with developmental and physical disabilities; however, although there is substantial research on the health and injuries of children with all disabilities (both physical and mental delay), little research has explored home injury risks of children with autism spectrum disorder (ASD) specifically.[15–18] To date, injury prevention guidance has used an age-based understanding of development and risk level to create evidence-based approaches that have demonstrated success in reducing childhood injury rates.[2] For example, risk factors for falls down the stairs include young children learning to walk and/or use of baby walkers.[19,20] Children with ASD vary widely in their developmental trajectories, but generally, children with ASD demonstrate higher rates of mental and/or physical developmental delays as compared with their same-aged neurotypical (NT) peers.[21] Guidance on reducing unintentional home childhood injuries in particular typically focuses on children aged 0 to 5; however, it is suggested that children with ASD may require prevention efforts that extend into older ages as a result of these developmental delays.[18]

In addition, children with ASD are at a higher risk of injury resulting from self-injurious behavior (SIB) relative to same-age NT children. Research estimates that up to 36% of children with ASD engage in SIB and that it is a common cause of ED visits and hospitalizations among children with ASD.[22–24] These behaviors occur as a result of complex interactions between developmental disabilities and the environment and are physical acts that are defined by their potential to create injuries.[25,26] Self-injury as an aspect of the ASD behavioral phenotype differs from other intentional injury actions such as self-mutilation because self-injury, in individuals with ASD, is often maintained by specific actions of others and can be directly related to communicative deficits associated with ASD.[27] As such, the resulting self-harm is a collateral to the response and not the intention, the defining quality of an unintentional injury.[27] Common forms of SIB exhibited by persons with ASD include head banging (with a body part or an object in the environment), body hitting (with a body part or object in the environment), self-biting, scratching with nails (including digging or picking in skin with nails), pinching/pulling skin, poking or gouging cavities, hair pulling, rubbing, and mouthing.[28,29]

Despite the fact that children with developmental and physical disabilities have been shown to be at an increased risk for injuries, much of the childhood injury prevention research focuses on children without disabilities.[30,31] Fires and burns are the leading cause of home injury deaths among those 14 years and younger. Most of these deaths are caused by house fires, which often can be prevented with working smoke alarms or by addressing overloaded

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electrical systems.[26] Falls are the leading cause of nonfatal home injuries among children and youth, with those from birth to 5 years at the highest risk. Falls are responsible for more than 2 million pediatric ED visits per year. An estimated 1.5 million of these falls occur in the home.[32]

Little is known specifically about home injury experiences of children with ASD. This is of considerable concern because childhood ASD diagnosis is on the rise, and emerging evidence suggests that children with ASD have injury risks that differ from the general population.[16,17,30,33] Because home is the most common location for childhood injuries, this suggests an urgent need for research to address home safety for these children, including injuries caused by SIB.[34,35] This is a mixed methods exploratory study to describe the causes of burns, falls, and self-injury behavior among children with ASD seeking care in an urban ED to provide early evidence insights for prevention strategies.

METHODS

This study is a retrospective chart review of children with ASD who were evaluated for an unintentional home injury, restricted to falls, burns, and SIB, in an urban academic pediatric ED. This urban mid-Atlantic level 1 pediatric trauma center has 35,000 visits annually. Inclusion criteria for the chart review were ED encounters between 2014 and 2016 for an unintentional injury [*International Classification of Diseases, Ninth Revision* (*ICD-9*) 800–959] by patients ranging in age from 2 to 19 years, with a documented diagnosis of ASD (*ICD-9* 299) in their electronic medical record, including past medical history and ongoing problem list.[36,37] The minimum age of 2 years was selected because diagnosis at this age is typically predictive of continued ASD diagnosis at later ages. Furthermore, these individuals engage in behaviors that put them at risk for injury, such as SIB.[38] Patient encounters were excluded from this study if the chart review indicated child abuse or suicidal ideation or if the location of the injury was somewhere other than the home. This study was institutional review board approved at the university.

A trauma hospital coordinator trained in Epic Systems, the hospital's electronic medical record database, generated a list of eligible records of patients with ASD using the *ICD* codes specified above. The information collected included age, race, sex, primary diagnosis, injury disposition, if the parent was present at the time of injury, a short case narrative describing the circumstances of the injury, whether the patient received a consultation from a specialist or other service as documented in the record, and the outcome of the visit. The Epic query generated an Excel file, version 15.3, based on the variables specified. Univariate and bivariate statistics were used to describe the sample population and compare key characteristics across types of injury. Distributions for these variables are presented, however, because of the overall sample size and small cell sizes; only analysis of variance was used to compare age across injury types.

Qualitative coding was used to determine commonalities among the type of injuries. To code the case narratives, a traditional content analysis was conducted.[39] The specified variables that were coded included the type of injury (classified as fall, burn, or SIB), the location where the injury occurred, and the mechanism that caused the injury. One author served as the primary coder. However, to assess coding, a random sample of 25% of the charts were reviewed by 4 of the authors. For codes that were discordant, the 4 authors discussed until consensus was achieved. Based on coauthor consensus, the coding scheme was finalized. Examples of the content for each code are provided with a brief description of the case that included the child's age and sex.

RESULTS

The inclusion criteria yielded 239 cases of ED encounters by children with ASD in their chart. A total of 211 cases (88%) were excluded from analysis because the patient was brought in for an emergency psychiatric evaluation for danger for intentional self-harm or violence directed toward others (n = 76, 32%), child abuse (n = 33, 14%), suicide (n = 23, 10%), other complaints (eg, insect bites and allergic reactions) (n = 23, 10%), feeding tube complications (n = 8, 3%), or the location of the injury was not at home (n = 48, 20%). The remaining 27 cases (12%) were determined to be an unintentional injury at home resulting from a burn, fall, or SIB.

Most of the sample were male (n = 24, 89%), Black (n = 13, 48%), with a mean age of 7.8 (SD, 4.9) years, and with an age range from 2 to 19 (18, 67% older than 5 years). The most common unintentional mechanism was a fall (44%), followed by SIB (33%) and burns (22%). Several of the cases (n = 17, 63%) did not report in the narrative if parents were present at the time of the injury. A consultation from a health care specialist or other ED service (eg, social work) was provided to a little less than half (n = 13, 48%). Most of the children were discharged from the ED (n = 22, 81%) after treatment as the disposition of the ED visit. However, there were differences in average age of those presenting for burns, falls, and SIB ($F = 4.485$, $P = 0.02$) (Table 1).

All cases identified at least 1 mechanism contributing to the injury; in 2 cases (1 fall injury and 1 SIB), 2 items were mentioned. Of the 29 items identified, most involved a house feature that was not stairs (24%); some included stairs, furniture, or a combination of a foreign object and grill (21%); and few identified food/beverage/liquid (11%). Table 2 provides details of the mechanism associated with each type of injury.

The text of the chart review provided descriptions for each of these injuries. There were some commonalities identified for each category of injury (falls, burns, and SIBs), which is discussed within each injury type below.

Burns

Descriptive themes that emerged from reviewing text in the chart suggested that most of the burns (n = 5) were scalds caused by hot liquid (boiling water, soup, and coffee) and/or resulted as a collision with another person into something hot (n = 4, 67%). This is illustrated by these chart entries:

[Patient] was with father, he was pushed into hot grill by a friend and [right] hand was burned. (male, age 11)

17 [year old] with [history of] mild dev [developmental] delay ran into brother who was carrying a pot of boiling water. Splash burns to face, chest and back…. (male, 17)

Fifty percent (n = 3) of all burn injuries resulted from cooking. However, only 1 injury was from a child pulling a pot off of the stove. More commonly, the child had contact (n = 2, 30%) with others who were cooking, as highlighted by this chart entry:

Patient's father was attempting to make rice with boiling water when his mother was rushing past him to the door and tipped the boiling water he was carrying onto the patient's face. (male, age 3)

Falls

The chart review highlighted that half (n = 6) of all fall cases involved stairs as described in these examples:

TABLE 1. Injury Type by Demographics and Outcome of ED visit (N = 27)

		Sample	Burn	Falls	SIB
		n (%)	n (%)	n (%)	n (%)
Categorical		27 (100)	6 (100)	12 (100)	9 (100)
Sex	Male	24 (89)	6 (100)	9 (75)	9 (100)
	Female	3 (11)	0 (0)	3 (25)	0 (0)
Race	Black	13 (48)	2 (33)	8 (66)	3 (33)
	White	7 (26)	2 (33)	2 (17)	3 (33)
	Unspecified	7 (26)	2 (33)	2 (17)	3 (33)
Adult present	No	1 (4)	1 (16)	0 (0)	0 (0)
	Yes	9 (33)	3 (50)	3 (25)	3 (33)
	Unknown	17 (63)	2 (44)	9 (75)	6 (67)
Consult	No	14 (52)	3 (50)	6 (54)	5 (56)
	Yes	13 (48)	3 (50)	6 (46)	4 (44)
Outcome	Discharged	22 (81)	5 (83)	11 (92)	6 (67)
	Admitted	2 (7)	1 (17)	1 (8)	0 (0)
	Transfer	3 (11)	0 (0)	0 (0)	3 (33)
Continuous, mean (SD)					
Age		7.8 (4.9)	6.7 (3.6)	5.7 (3.5)	11.44 (5.3)*

*$P < 0.05$.

Fell down 12 steps, unresponsive on EMS arrival. Awake and looking around, but not speaking since event. (female, age 14)

2 [year old] with autism…falling down ~10 steps. Cried right away, no vomiting, acting normally…. (male, age 2)

A third (n = 4) of the falls in this chart review involved furniture. In 2 of the cases, children fell out of bed, and in one instance, a child fell into a table as described by the text from this chart:

Was running at home, slipped on floor and hit mouth on side table. Cut inside of lip, initially with significant bleeding. (male, age 2)

An important finding from the charts of fall patients is that one third (n = 4) involved seizures that either contributed to the fall (n = 1) or occurred because of the fall (n = 3). For example:

Contributed to the fall – "Seizure [patient] fell and hit head on toilet." (male, age 8)

TABLE 2. Unintentional Home Injuries by Items

Injuries (n = 27)	Total Items Identified* (n = 29)
Burns	Boiling liquid (4)
Total injuries: (5) 22%	Grill (1)
	Total items: 5
Falls	Stairs (6)
Total injuries: (12) 44%	Furniture (4)
	Housing feature not stairs (4)
	Total items: 14
SIB	Inserted foreign object (5)
Total injuries: (9) 33%	Furniture (2)
	Housing feature not stairs (3)
	Total items: 10

*These are not mutually exclusive; 1 chart could have mentioned more than 1 item.

After the fall – "…brought in by EMS as a trauma activation after she fell over a second landing and fell the equivalent of 13 steps down to the floor. She landed on her head on a tile floor. She had a brief loss of consciousness followed by witnessed seizure activity lasting approximately 30 seconds and was postictal in the ambulance." (female, age 4)

Self-Injury Behavior

Some SIBs (n = 5) were caused by inserting foreign objects into the body or repetitive hitting (either oneself or against an object). For example:

9 [year old] who presents with crayon in the right ear noted by parents today. No blood or drainage from the ear. (male, age 9)

Bruises to face after hitting himself in the face with his fist. (male, age 19)

This chart review identified that a third (n = 3) of the SIB cases resulted from frustration by the patient as described below:

He was playing in the basement where he got frustrated that the door did not unlock and banged on the glass and shattered it and cut his wrist. (male, age 12)

At dinner tonight, he became agitated, and kicked his right foot into a table or wall. The toe was swollen with injury and bleeding to the right great toenail. (male, age 19)

DISCUSSION

The current study found that falls were the main cause of ED visits for home unintentional injuries among children with ASD, which is consistent with existing evidence on leading causes of nonfatal home injuries for children.[8] This study also supports findings that one of the most significant hazardous contributors to falls at home is stairs.[5,34] Most falls at home involve stairs and environmental modifications, such as stair gates, are often suggested for younger ages.[7] The higher prevalence of seizures in ASD has been documented, and in this study, seizures were

associated with falls among children with ASD.[40,41] Although seizures can be a complication from a fall, this study suggests that anticipatory guidance for fall prevention among children with ASD could include the identification of seizure triggers and should be considered in future research for unintentional injury prevention for children with ASD.

Scalds have been found to be the most common mechanism of childhood burn injuries for children 1 to 5 years old.[42,43] Although the sample of the current study was small, it is consistent with existing research that found that scalds were the most common form of home injury burns. Other studies have reported, however, that gasoline and electrical burns were the common mechanism of burn injury for children older than 5 years, suggesting the need for age-specific injury prevention to reduce burns.[43] Children with ASD in this study presenting with burns had an age range of 2 to 11 years with a mean of 6.7, and 4 were more than 5 years old. There were no gas or match fire burns, suggesting the age guidance for burn prevention may need to be tailored for children with ASD. Research with a larger sample of burn victims is warranted to guide prevention efforts.

The current study found that children who sought care for SIBs were older than those with burn or fall injuries, again identifying a possible need to extend anticipatory guidance for injury prevention for children with ASD to include older children. Currently, we were unable to identify anticipatory guidance specific to NT children who engage in SIB. This may be because of the lower prevalence of SIB in this population and pattern of SIB displayed by NT children. For individuals with ASD, SIB occurs in approximately 30% of individuals, whereas for NT individuals, only approximately 15% of NT children will engage in SIB.[23,44] Furthermore, for individuals with ASD, there is evidence that SIB will persist through childhood and create injuries if left untreated, whereas for NT individuals, SIB typically no longer occurs by the age of 5 years, likely will not create many injuries, and will not require professional assistance to be treated.[38,44,45]

Current treatment of SIB shares many similarities with other public health injury prevention strategies (eg, falls), using interventions to address the environment and behavior modifications to reduce injury risk. Both behavioral and pharmacological interventions are evidenced-based interventions for reducing SIB, yet numerous studies on the prevention of SIB also focus on the goal of implementing prevention practices in the home, with parents as a key real-time collaborator for prevention.[22,46–49] Because SIBs are not covered as part of primary care injury prevention guidance, it is unclear if parents consider their doctor a resource in trying to prevent SIBs. For parents with little or no access to ASD therapeutic services, doctors can be important in preventing SIB-related injuries. In addition, there may be an opportunity for improved collaboration between injury prevention practitioners and those providing therapeutic treatment to prevent SIB to promote multilevel intervention.

Home injury prevention practice is defined as modifying the home environment to reduce access and/or eliminate exposure to physical hazards.[2,50] Home injury prevention practices, when used properly, reduce injuries, although challenges for parents to adopt recommendations and apply them correctly at home persist.[34,50] Furthermore, the literature on prevention of home injuries is based on neurotypically developing children and their developmental age and lacks consideration of how home injury prevention practices need adjustment for children with ASD, as well as omits discussion on SIBs. More research is needed to determine how to adapt current practices for this population and how to advise parents to keep children with ASD safe from home injury.

As with all retrospective chart reviews, there are some limitations in interpreting the data. For example, charts are for medical treatment and not for research; therefore, some information was not available in every chart, and the percentages reported may underestimate injuries sustained by children with ASD. The sample is a clinical population seeking health care in an urban ED and as such may not be representative of families of children with ASD. In addition, we could have underestimated the patients with ASD given reliance on listed diagnosis in the chart; we did not confirm diagnosis, limiting our sample size. Similar research should be conducted in other clinical settings, including primary care clinics, and among emergency medical services calls that did not result in transport to the ED. It is possible that nonemergency health care patient populations may have different characteristics.

Although these limitations exist, this retrospective chart review study has described the unintentional home injuries of children with ASD seeking emergency care. This research highlights the importance of developing evidenced-based modifications for common childhood home injuries like falls and burns in injury prevention for children with ASD, as well as to consider addressing SIB.

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