



Concussion Risk Related to Trampoline Activity among Children and Adolescents

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Abstract

Trampolines are an exhilarating form of physical activity for children and teens. The use of trampolines has expanded to commercial facilities in the past decade. Studies have identified the injury risk from the use of trampolines including concussions. The purpose of the study is to identify the mechanisms for concussions from trampoline related injury and identify potential countermeasures. Methods included the review of data from 2013 to 2017 from the National Electronic Injury Surveillance System (NEISS) for concussions from trampolines. Results identified 358 cases during the 5 year period with an estimated 9,007 cases. Many of the concussions occurred by falling off the trampoline with about 15% of concussions occurring from the head bouncing off the middle part of the trampoline. Children 6 and under had a 3.4 times greater risk of sustaining a concussion from falling off the trampoline compared with older children. Older children had a 3.7 times greater concussion risk from having more than 1 person on the trampoline compared with younger children. Recommendations include the non-use of trampolines for small children and supervision for older children. Parents should be warned about concussion risk from trampolines from both home use and commercial parks.

Keywords: Injury; Concussion; Recreation; Children; Adolescents

Introduction

Trampolines are a popular and exhilarating activity for people of all ages. Children and adolescents represent the majority of trampoline users and is a popular activity within the home/backyard environment. The past decade has experienced an increase in trampoline parks and activity centers. According to a report the number of trampoline parks has increased from 3 to over 800 the past 10 years [1]. This has increased the use of trampolines along with the use of trampolines in the home environment. Recent studies have highlighted the risk for injury from trampolines and the American Academy of Pediatrics has stated that trampolines are not recommended for recreational use [2-5]. The most common injuries from trampoline activity include sprains, strains and overuse injuries. More severe injuries involved fractures and concussions. A 2019 study by the centers for disease control, concussions from trampolining averaged 4,906 concussions annually and was in the same category as baseball, softball and skateboarding with similar number of concussions [6]. A study conducted by Doty [7] identified more injuries from trampolines occurring at the home versus commercial facilities but also noted that there was a higher rate of fractures and dislocations at the commercial facilities. Even though concussions represent a small portion of overall trampoline related injuries, an individual that exhibits immediate (e.g., dizziness, headache, visual changes etc...) or delayed (e.g., persistent headache or dizziness 24 h to 72 h after the concussive event) should seek medical attention. Individuals that sustain a concussion that do not seek medical attention may be at risk for chronic symptoms and impairments that can negatively influence physical, emotional, social, sleep, and academic functioning. Moreover, concussed individuals that continue to participate in activities (i.e., jumping on a trampoline) where they could incur more direct or indirect (e.g., whiplash) concussive forces may incur subsequent injury with possible chronic and/or catastrophic consequences (e.g., Second-Impact Syndrome: SIS). The purpose of this study is to investigate the epidemiology of concussions from trampoline use including the mechanism of injury and to identify potential prevention measures to decrease concussion risk of the activity.

Methods

Data with a product code of 1233 (trampolines) was obtained from the National Electronic Surveillance System (NEISS) for years 2013 to 2017 [8]. Injuries were initially treated at a hospital ED

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Table 1: Estimated total number of concussions in US due to mechanism^{*}.

	N	%
Falling off Trampoline	4865	54.10%
Hitting Part of Trampoline Structure ^{**}	1402	15.60%
Concussion from Bounce of Trampoline	1350	15.00%
Collision with another jumper	988	11.00%
Head to Knee Contact	256	2.90%
Not Activity Related	146	1.60%

^{*}Based on reports from the descriptive narrative presented for each case

^{**}Parts of structure would include the poles for the netting or the trampoline structure and springs

that was participating in the NEISS. Information extracted by NEISS includes the product or products related to the injury; descriptions of the injury, which includes primary diagnosis, causes of injuries and type of activity involved, anatomical location, descriptions of the ED visit, disposition; including hospitalization. General demographic characteristics of the injured person and a brief comment/narrative of the injury incident were also reviewed. The location of the injury was also analyzed. The locations listed in the NEISS database include home, ranch, street or highway, other public property, mobile home, industrial place, school, place of recreation or sports, or not recorded. The narratives for all records reported for this study were reviewed and two additional variables were created to indicate the mechanism of injury and if the individual was alone or with others when injured on the trampoline. These two variables were not extracted from the NEISS database but developed by the researchers from the narrative of the NEISS database. The categories developed for the mechanism variable included falling from the trampoline, hitting part of the trampoline structure such as the metal frame, springs or legs, having a concussion as a result of the head or neck bouncing off the soft part of the trampoline, collision with another jumper and the knee contacting the head during the jumping activity. The injury diagnosis was specific to concussion only for the study. There were two age groups developed for the calculation of risk with the younger age group being children ages 0 to 6 and the older age group being children ages 7 to 19. NEISS receives and collects data reports from a probability sample of hospital emergency departments in the United States and uses the information to estimate national patterns of product related injuries [8-11]. Some of the emergency departments are located in children's hospitals. Each emergency department participating in NEISS carries a statistical weight that determines how it represents all US emergency departments. We used the NEISS data and weightings to calculate injury estimates. Calculation of a 95% Confidence Interval (CI) for the estimated number of injuries was based on the generalized estimated sampling error for NEISS data provided by the CPSC [11].

Results

The analysis of the concussion data from 2013 to 2017 specific to trampolines identified 358 totals ED reported concussions that resulted in an estimated 9,007 concussions in the US during the study period. The majority of cases were to children 18 or younger (>95%) with only a small percentage representing young adults and 1 case of a 48 year old male. Males accounted for 58% of the injuries and 54% cases were reported as Caucasian. Not surprising was that the primary location of injury was in the home location with 43% and another 15% occurring at a place of recreation such as a trampoline park or school. There were 38% that did not report a location for the

injury event. Regarding the mechanism of the concussion (Table 1), most (54%) occurred during falls from the trampoline with the second most common mechanism (15%) as a concussion from falling and hitting one of the structures of the trampoline. Finally another 15% were attributed to the head hitting the trampoline jumping platform. Less than 2% of the concussions reported were related to, but not directly due to the trampoline activity. For example, one such report was a child on an ATV that ran under the trampoline structure and having a concussion when hitting the trampoline structure. Other common mechanisms were collisions with other jumpers on the trampoline, hitting the head on the metal poles or other parts of the trampoline and having head knee contact while trampolining. Finally, 19% of the concussions occurred while the individual was on the trampoline with other jumpers. When analyzing the mechanism by age group (Table 2) almost 73% of the concussions for the younger age group were due to falls, whereas the older age groups had a higher percent of concussions from the activity and hitting the surface of the trampoline and collisions with other children. This resulted in a 3.4 times greater risk (95% CI 2 to 5.9) of having a concussion due to a fall for the younger age group than for older children. For older children, the risk of collision with another child was 3.7 (95% CI 1.27 to 10.6) greater than for younger age groups. There were no significant differences for other mechanisms between the age groups.

Discussion

Other studies have identified trampolines as an at risk activity for injuries, especially to younger children [2-6]. This study also identified trampoline activity as an at risk activity for concussion injury. Since children are the primary users of trampolines, it is not surprising that a majority of injuries occurred to children. But this should also increase the concern of concussion risk to young children, since they are of developmental age. In a study by Beno et al. [11] it was reported that parental knowledge of the 5 key safety recommendations for trampoline use was low. Therefore, parents and caregivers need to be aware of the potential concussion risk from trampolines. One of the major findings of the study was the occurrence of concussions from an individual hitting the surface of the trampoline and not from falling, colliding with others, or hitting a hard surface. This is likely more of a concern with very young children as they may not have the muscular strength in their neck to prevent the head from snapping back onto the surface during a fall. This finding reinforces that extreme caution be used when playing on trampolines and that it would be best to not use trampolines at all. Another important finding from the study results is that almost 18% of the concussions were to children under the age of 6. The American Academy of Pediatrics has recommended that children under this age not use trampolines [5]. The results also identified that more concussions occurred with trampolines in the home environment instead of trampoline parks. This counters findings from Doty et al. [5,7] that found more serious injuries were found at trampoline parks. With this finding that most of the concussions occurring in the home environment, parents and caregivers would be an important target population for trampoline safety education. With the concern many parents have toward children playing high concussion risk activities such as football and soccer, parents should also beware of the concussion risk of other low impact or no impact activities that carry a much lower risk of concussion but could still contribute to the dangers associated with concussion. For this reason, the efficacy of wearing a protective helmet or knee pads such as those used for skateboarding for older children should be investigated as a potential countermeasure to head

Table 2: Concussions by Age Groups and Mechanism.

	Fall	Activity	Trampoline Structure	Collision	Head to Knee	Total
Ages 0-6 (#/%)	64	8	10	4	0	86
	72.70%	9.10%	11.40%	4.50%	0%	24.60%
Ages 7-19	119	57	30	40	16	262
	45.40%	21.80%	11.50%	15.30%	6%	38.80%
Total	183	65	40	44	16	348
	52.50%	18.80%	11.50%	12.60%	4.60%	

injury risk. It appears from this study that education on the dangers of trampolines is still a needed and important issue and efforts should be continued to disseminate information in venues such as commercial trampoline parks as well as retail stores where parents and caregivers can purchase trampolines. The limitations of the research include the lack of full details of the concussion and injury mechanism since only a narrative is provided in the database. The narrative is dependent on the emergency room personnel and details vary from injury to injury. Follow up studies should identify specific details of the concussion along with the attributing environment.

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