Childhood trampoline injuries

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ABSTRACT

INTRODUCTION: With the increasing use of recreational trampolines, more injuries are seen in emergency departments (ED). Little is known about the relationship between adherence to safety precautions and injuries. This retrospective study aims to describe the types of injuries and the precautions taken when using trampolines, and to investigate the relationship between injuries and safety precautions.

METHODS: We reviewed patient lists and the medical records of children younger than 18 years who were treated between 1 April and 30 September 2014 at the ED of Hospital Unit West, Denmark. Demographic data and type of injury were recorded. Patients or guardians were contacted for a structured telephone interview to describe the safety precautions they had taken before the injury occurred. A total of 113 patients were identified, and 100 patients were included in the phone interviews. A total of 13 patients were excluded due to incorrect/missing phone numbers or lack of a Danish home address.

RESULTS: 6% of all children treated in the ED had trampoline-related injuries. A total of 58 (51.3%) patients had fracture injuries, and 55 (48.7%) patients had non-fracture injuries. 4% had complied with all five recommended safety precautions.

CONCLUSIONS: This study describes types of injuries and safety precautions related to trampoline use. 6% of all children in the ED had an injury related to trampoline use. 4% complied with all five recommended safety precautions.

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TRIAL REGISTRATION: not relevant.

The trampoline was invented for use in the circus world in 1936 in the United States [1, 2]. From 1940 to 1960, the use of trampolines became a sport [1, 2], and in the late 1970s, the trampoline started being used in amusement parks, schools and day care facilities [3, 4]. Within the past 20 years, the interest in trampolines has grown, and many families now have trampolines in their backyards. This has resulted in an increase in trampoline injuries in the children who are seen in emergency departments (ED) [1, 2, 5]. Safety precautions may lower the risk and the severity of injuries [6, 7]. In Denmark, five non-validated recommended safety precautions exist to reduce trampoline injuries: 1) Do not jump more than one person at the same time, 2) Use a safety net, 3) Check the safety of your trampoline regularly, 4) Make sure there is adult supervision when trampolines are used by children under six years of age, 5) Do not do somersaults on a trampoline [6]. Beyond these recommendations, it is commonly believed that sunken trampolines may reduce injuries.

The epidemiology for trampoline injuries and the focus on safety guidelines in Denmark is based on international studies [8]; the existing Danish studies describing the types of trampoline injuries are more than 30 years old [3, 4]. International studies describing the incidence and types of trampoline injuries are more detailed [9, 10], and limited safety precautions have been investigated [2, 11-13].

With the increasing popularity of recreational trampoline use, parents are the best advocates for the safety of their children. However, a recent study concluded that knowledge of trampoline safety among parents was low [14] and that policy statements regarding recreational trampoline use should be updated [7]. To our knowledge, no previous studies have investigated the adherence to all five recommended safety precautions and the correlation between adherence to safety precautions and injuries. Understanding the types and severity of the injuries related to the use of safety precautions is a necessary basis for implementing recommendations for safety guidelines regarding trampoline use in private homes.

The aim of this study was to describe trampoline-related injuries and the precautions taken when using trampolines.

METHODS

This retrospective study was conducted at the ED of Hospital Unit West, Denmark, which consists of three public hospitals (Herning, Holstebro and Ringkoebing) serving approximately 300,000 people. The study was conducted in two phases (**Figure 1**).

The first phase included descriptive and retrospective data collection (age, gender, distribution of injuries, types of injuries, location and treatment of injuries). Data were collected from the regional medical records archived from 1 April to 30 September 2014, which included the summer months owing to an expected increase in the usage of trampolines during these months [1, 2, 5]. All patients under 18 years of age who were treated in the ED were identified through patient lists. All patients who had been treated with an injury re-

ORIGINAL ARTICLE

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lated to trampoline use were identified by scrutinising patient medical records. Using predefined inclusion and exclusion criteria (Figure 1), we included a total of 113 patients.

The second phase consisted of a structured telephone interview using phone numbers extracted from a regional database. To obtain optimal contact, patients were contacted after work hours (4-7 p.m.) on weekdays. Patients were registered as unreachable after three unsuccessful contact attempts made on three different days. A total of 13 patients were excluded due to incorrect/missing phone numbers or the lack of a Danish home address. The primary endpoints of the study were number of trampoline-related injuries. The secondary endpoints were: 1) types of injuries (fracture versus non-fracture injuries and dislocation versus non-dislocation injuries), 2) adherence to national recommended safety precautions, 3) types of trampolines, and 4) treatment.

Statistics

Descriptive statistics were introduced as percentages. Correlations among variables were tested using regression analysis. A p-value below 0.05 was considered statistically significant. Analyses were performed using Stata 14 (IC) (StataCorp, 2015).

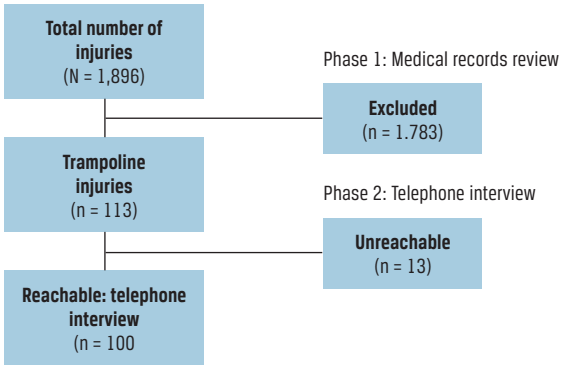
Ethics

The Central Denmark Region's Committees on Health Research Ethics granted a waiver for the study (cf. inquiry 35/2015). Furthermore, the study was approved in accordance with a directive from the Danish Data Protection Authority (case file: 1-16-02-217-15) and the Danish Health Authority (case file: 3-3013-1095/1). The patients' parents or guardians gave oral informed consent to proceed with the telephone interview due to the young age of the patients.

Trial registration: not relevant.

FIGUR 1

Flow chart with inclusion and exclusion criteria.

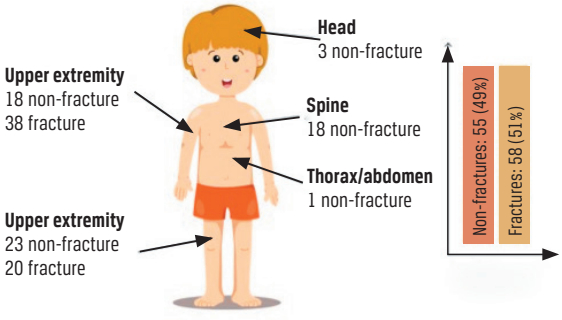


Inclusion criteria:
- Injuries from 1 April to 30 September, 2014
- Children from 0 to 17 years old
- All types of injuries related to trampoline use

Exclusion criteria:
- Injuries that could not be firmly associated with the use of trampolines

FIGUR 2

Distribution of fracture and non-fracture injuries to the body (N = 113).



RESULTS

Out of 1,896 patients under the age of 18 years, a total of 113 (6%) patients presented with trampoline-related injuries. The telephone interview included a total of 100 patients, and 71% (n = 71) of all injuries occurred during private use of trampolines in their own homes, 20% (n = 20) at the homes of family and friends, or 8% (n = 8) at amusement parks and playgrounds. A total of 93% of all trampolines were of an outdoor type and 7% of an indoor type. Of all outdoor trampolines, 15% were sunken trampolines. 1% (n = 1) of the injuries occurred at school. 11% (n = 11) of the patients had previously been injured on a trampoline. One patient had epilepsy and was found unconscious next to the trampoline.

Types of injury

Out of 113 included patients, a total of 58 (51.3%) had a fracture injury confirmed by diagnostic imaging, and 55 (48.7%) had non-fracture injuries (distortions and contusions). Of all fractures, 31.5% were dislocated fracture injuries (n = 18) and 68.5% non-dislocated fracture injuries (n = 39). An insignificantly (p = 0.51) higher proportion of injuries were seen in girls 54% (n = 61) than in boys 46% (n = 52). We found an insignificant difference in the number of injuries during each month from April to September (p = 0.64).

The majority of injuries were seen in patients who were older than six years (77%) and especially between nine and 13 years of age (66%). We found no patients over the age of 15 years in the study. Children under six years of age represented 23% (n = 26) of the total number of injuries.

The distribution of injuries is shown in **Figure 2**. All fracture injuries were located on the upper and lower

extremities. A recurrent non-fracture injury was distortion of the spine, which accounted for 29% of the non-fracture injuries. The majority of patients with spinal injuries had cervical pain (61%), whereas there was an even division among pain in the thoracic, lumbar and sacral parts of the spine. Multiple injuries in the same body part were counted as a single injury (for example, pain in the spine). Five patients had non-fracture injuries to several body parts, which accounted for an additional eight injuries.

Out of 58 patients in the fracture group, 77.6% (n = 45) were treated conservatively (immobilising bandage or cast treatment), and 22.4% (n = 13) required admission for surgical procedures under general anaesthesia. In the non-fracture group, two patients (aged one and eight years) had been unconscious and were admitted for observation for cerebral concussion with no further complications. No other patients in the non-fracture group were hospitalised, and no patients had surgery performed. No severe life-threatening injuries were found.

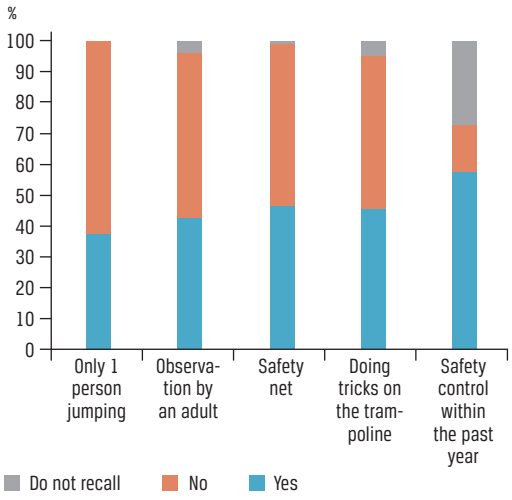
Safety precautions

We were able to include 100 patients for the structured phone interview. The interviewed group had nearly the same number of patients with fracture injuries (n = 51 (51%)) and patients with a non-fracture injury (n = 49 (49%)).

Results regarding safety precautions are presented in **Figure 3**. A total of 62% of all patients had been jumping alongside someone else on the trampoline, and 53% did not have adult supervision. Furthermore, 52% did not use a safety net, and 46% were doing tricks on the trampoline. However, 58% had a yearly security check of their trampoline. 4% of all patients complied with all five safety precautions, whereas 55% complied with two to three safety precautions. A total of 6% did not comply with any of the five safety precautions.

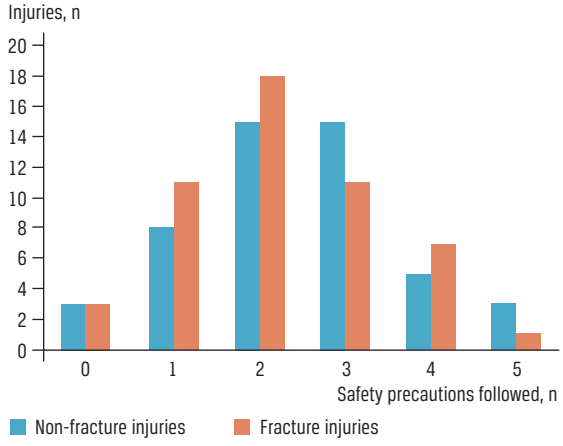
Figure 4 shows the proportions of fracture and non-fracture injuries and adherence to recommended safety precautions. When complying with only 1-2 recommendations, there was a higher proportion of fractures (n = 29). Among those complying with all five recommendations, only one fracture was found.

FIGUR 3



Safety precautions.

FIGUR 4



Proportions of injuries and adherence to safety precautions.

DISCUSSION

This study showed that of all children in the ED, 6% had injuries related to trampoline use, and out of these only 4% complied with all five recommended safety precautions.

This is the first study to describe the correlation between adherence to recommended safety precautions and the types of injury related to trampoline use. No other study has investigated the risk and severity of fracture in correlation to all five recommended safety precautions.

Of all children seen in the EDs in the summer months, 6% had an injury related to trampoline usage, and almost half of these had a fracture. A total of 13.2% of all patients (n = 15) required hospital admission. Other studies have shown a representation of trampoline injuries of 2% over a five-year period [15] and 1.5% over a four-month period [12]. The rate of hospital admission varied from 3% to 14% [7, 12, 15]. This is a high number of visits and a large burden on the healthcare system. Our findings reflect the popularity of trampolines in private homes and are in accordance with other studies [2, 11, 16]. Both fracture and non-fracture injuries affected primarily the upper and lower extremities. This trend is in line with previous studies showing a higher proportion of injuries to the extremities [2-4, 8]. Despite a total of 18% head

(n = 3) and spine (n = 18) injuries, we found no serious injuries to the spine or any complex conditions following the injuries. Other studies show that head and spine injuries accounted for 10-28% of all trampoline-related injuries [11, 17-19] and that 0.5% of all injuries resulted in permanent neurological damage [20]. Our study is limited by its small sample size, and we cannot conclude that trampoline use is safe.

Only 4% of all patients complied with all five of the recommended safety precaution. A study by Beno et al found that trampoline safety knowledge among parents was low, and only 8.2% knew all five recommended safety precautions [14]. Due to its design, the study cannot investigate correlation between following guidelines and risk of injury. However, it may be speculated that the trampoline users who did not have injuries in need of treatment at the hospital were more adherent to guidelines. A knowledge gap exists, and the safety guidelines need to be brought to the attention of trampoline users; we believe that the high number of visits to the ED from trampoline injuries could be reduced if guidelines were followed.

The majority of injuries were seen in patients who were older than six years of age (77%) with a rise between nine and 13 years (66%). In 1992, Woodward et al found that most injuries are seen in children from six to ten years of age [20]. Perhaps the children using trampolines are older now or parents have grown more conscious about safety when smaller children are using trampolines.

The primary limitation of this study is its retrospective observational design, and the time gap may have introduced recollection bias. Due to the retrospective design of this study, we are unable to show a direct effect of the recommended safety precautions on the injuries. This design cannot prove causality, only association. However, it would be unethical to conduct a prospectively designed study randomising on the use of safety precautions. This study shows a small part of trampoline injuries in Denmark; on this basis, we recommend that a larger study be conducted to obtain a higher degree of certainty in the estimates. The telephone interviews were conducted more than one year after the time of injury, but none of the interviewed persons had difficulty recalling the injury.

CONCLUSIONS

6% of all children in the ED had an injury that was related to trampoline use. In 4% of the cases, the patient had complied with all five recommended safety precautions. Further research is called for to clarify the best implementation of safety precautions. We recommend a national or international interventional study designed to provide information on the effects of the recommendations.

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