

Orthopedic injuries associated with backyard trampoline use in children

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Introduction: Trampolining on an outdoor oval or circular trampoline is a popular activity for children but is associated with a number of orthopedic injuries, especially in children between the ages of 5 and 15 years. In this paper we review the orthopedic injuries in children associated with backyard trampoline use, through our experience with a series of children admitted to the Winnipeg Children's Hospital, the only tertiary care pediatric centre in Manitoba. **Methods:** We reviewed the charts, x-ray films and operative reports for 80 children under 16 years old (mean 9 yr, with 14 [18%] children between 2 and 4 yr) with an orthopedic injury sustained when using a trampoline in the backyard. We noted the mechanism of injury and type and severity of orthopedic injury sustained. **Results:** Fifty-two (65%) children were injured on the trampoline mat, and 24 (30%) were injured when they were ejected from the trampoline. Sixty (75%) children sustained a fracture or fracture-dislocation. Forty-eight (80%) orthopedic injuries occurred in the upper extremity. No child died as a result of a trampoline injury. **Conclusion:** The use of the "backyard" trampoline by young children can cause significant orthopedic injury.

Introduction : La trampoline extérieure ovale ou circulaire est populaire chez les enfants, mais on l'associe à de nombreux traumatismes orthopédiques, surtout chez les enfants de 5 à 15 ans. Dans ce document, nous examinons les traumatismes orthopédiques subis par des enfants et reliés à l'utilisation à la maison de trampolines extérieures en nous en fondant sur l'expérience acquise auprès d'une série d'enfants admis à l'Hôpital pour enfants de Winnipeg, seul centre de soins tertiaires en pédiatrie du Manitoba. **Méthodes :** Nous avons examiné les dossiers, les radiographies et les rapports d'intervention de 80 enfants de moins de 16 ans (moyenne de 9 ans, dont 14 [18 %] avaient de 2 à 4 ans) qui ont subi un traumatisme orthopédique en utilisant à la maison une trampoline extérieure. Nous avons pris note du mécanisme du traumatisme, ainsi que du type et de la gravité du traumatisme orthopédique subi. **Résultats :** Cinquante-deux (65 %) des enfants ont subi leur traumatisme sur la trampoline et 24 (30 %) l'ont subi lorsqu'ils en ont été éjectés. Soixante (75 %) des enfants ont subi une fracture ou une fracture avec dislocation. Il y a eu 48 (80 %) traumatismes orthopédiques à la partie supérieure du corps. Aucun enfant n'est décédé des suites d'un traumatisme causé par la trampoline. **Conclusion :** L'utilisation à la maison par les jeunes enfants d'une trampoline extérieure peut causer des traumatismes orthopédiques importants.

Trampolining was introduced about 6 decades ago. Invented in 1936 by George Nissen, a circus acrobat, the apparatus was used in the training of fighter pilots during World War II.¹ Since 1950, the recreational use of the trampoline has become popular in the United States, Europe and Australia. In 1995, approximately 500 000 units were sold in the US by 14 different companies. The largest seller by far was the out-

door oval or circular trampoline used principally in residential backyards (A. Homan, Directorate for Economic Analysis, Consumer Product Safety Commission: personal communication, Feb. 16, 1995).

Injuries associated with the use of the trampoline have been well documented in the medical literature for the past 4 decades.^{1,2-9} Statistics from the Consumer Product Safety Committee in the US¹⁰ in 1996 revealed

that 63 870 orthopedic injuries in children younger than 16 years were associated with use of the trampoline. The majority (55 403) occurred in children between the ages of 5 and 15 years. There were 13 200 injuries to the upper extremity and 11 075 to the lower extremity. The number of home trampolines in this survey totalled 45 000. Three deaths were recorded, all secondary to severe head and neck trauma.

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The Canadian Hospital Injury Reporting and Prevention Program (CHIRPP), a computerized information database, records injuries in children from all 15 major children's hospitals in Canada. In 1996, 1042 injuries associated with trampoline use in children were seen in emergency departments.^{11,12} Of these injuries, 36% were fractures and 12% involved head and neck injuries. Interestingly, the majority (64%) occurred on the home trampoline.

A review of the literature recorded only 2 studies that addressed orthopedic morbidity in children associated with recreational backyard use of the trampoline, both in the US.^{1,4} We became concerned about the number of children presenting to the orthopedic service at the Winnipeg Children's Hospital with injuries sustained during use of a backyard trampoline. A review of trauma admissions to the hospital by etiology, revealed 1.6% were related to trampoline use.

Methods

The Winnipeg Children's Hospital is the only tertiary care hospital in Manitoba providing pediatric orthopedic surgery. We reviewed all hospital charts and x-ray films, as well as operative reports for children who presented to the hospital between January 1996 and October 1997. Information regarding the number of cases, age and sex of the child, date, location, mechanism, type and severity of injury, as well as treatment in each case was recorded.

Results

Eighty children with orthopedic injuries associated with recreational trampoline use (Fig. 1) were seen during the 21-month study period. There were 40 boys and 40 girls. They ranged in age from 2 to 15 years (mean 9 yr). Of note was that 14 (18%) children were between 2 and 4 years of age. Of the 80 children, 39 (49%) were in the 5-9-year age group.

Not surprisingly, most injuries occurred during the summer months from June to September (in 59 [74%] children).

The majority of injuries (41 [51%] children) occurred at a neighbour's home; 27 (34%) occurred at the patient's home. In only 10% of cases was an adult "supervising" the trampoline use.

Fifty-two (65%) children were injured while on the trampoline mat, and 24 (30%) were injured when they were ejected from the mat. Twenty-six (33%) children said the injury occurred when they were alone on the trampoline, whereas 28 (35%) sustained their injury while on the mat with 1 or more (up to 5) other children.

The most frequent injury was a fracture or fracture-dislocation (60 [75%] children); 20 (25%) reported only soft-tissue injury.

The most commonly fractured sites were the forearm (27 [45%] of the 60 children) followed by the humerus and elbow (21 [35%] children). Fracture-dislocations of the elbow (4 [19%]) and supracondylar fractures (17 [81%]) accounted for all the 21 injuries about the elbow. There were no associated vascular injuries and no knee dislocations.

The most serious injury was a fracture-dislocation of the cervical spine, with paralysis, in an 8-year-old boy who was ejected from the mat. There were no deaths.

Discussion

There is little information on pediatric orthopedic morbidity associated with backyard trampoline use. Our study represents the first Canadian study addressing this concern. Our study also represents a change from previous reports of injuries occurring during indoor, school-related or organized gymnastic activity to the outdoor privately owned trampolines.^{2,3,6,7,13}

As noted in other studies, the majority of injuries occur on the mat (52 [65%] in our series) and not from being catapulted off the mat onto a hard surface.^{1,4} Although slightly over half the children (51%) in our study recalled multiple jumpers on the trampoline, the actual incidence may have been underestimated, as reported by others.¹ There was no direct correlation between the severity of the injury sustained and number of jumpers on the mat in our series.



FIG. 1. Children playing on a backyard trampoline.



FIG. 2. A potential source of injury as a child prepares to jump onto a backyard trampoline from a stepladder to join a friend already on the trampoline.

A number of children were injured through imaginative uses of the trampoline, attesting to the ingenuity of children (Fig. 2). One child was injured while playing under the mat as other children were jumping on the trampoline. Another child experienced the excitement of jumping from a roof onto the trampoline and being ejected from it. Our youngest patient (2 yr of age) placed a narrow plank of wood to reach the mat surface then caught his leg between the edge of the mat and the frame, extending his leg backwards and fracturing his femur.

These innovative mechanisms might have been prevented had adult supervision been available. As reported by others, attempting somersaults or “flips” increased the chance of more serious injury.⁴

The basic function of the trampoline is to provide a “bounce” that will propel the performer vertically into the air. From a safety point of view, the smaller gravity force leads to less force on the back, neck or extremities of the child. Buchanan¹⁴ showed that the rectangular apparatus was “safer”

than the circular form commonly sold as a recreational backyard apparatus. A person weighing 30 kg displacing the mat surface 60 cm generates approximately 3.3 *g* of force. A child landing head first onto surrounding packed earth (grass) or gym floor from such a height could be fatally injured, as shown by fall height and impact absorption data from the Franklin Institute.¹⁵

There were several limitations to this study. First, it is a retrospective study. Furthermore, we could not obtain information on the number of trampolines in Winnipeg and the overall use of the trampoline by children. Hence, without a risk denominator, no conclusion can be made about relative risk of injury from the backyard trampoline versus other activities in which children participate. Because histories were obtained from the injured child or witnesses of similar age, a reporting bias may have been present.

Ensuring that only a single child uses the apparatus at one time or cautioning children to avoid more complicated “flips” would seem to be important. The fact that most children sustained their injury from a simple fall on the mat might suggest that in those cases, even with adult supervision, the injury may not have been preventable.

As suggested previously by the American Academy of Pediatrics¹⁶ and the Canadian Paediatric Society,¹² and supported by this study, we suggest the following guidelines for use of the backyard trampoline:

- Physicians should advise children and their families of the potential dangers of trampoline use.
- Children younger than 6 years should not use the trampoline.
- Children should not use the trampoline without adult supervision.
- No more than 1 person should be on the trampoline at any time.
- No flips or other advanced manoeuvres should be attempted.

We conclude that, in children,

trampolining is a high-risk activity and that the backyard trampoline has the potential for significant orthopedic injury.

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