Trampoline use in homes and playgrounds

A joint statement with the Canadian Academy of Sport Medicine

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INTRODUCTION

Trampolining was introduced in 1936 by George Nissen, a circus acrobat (1-7). Since the 1950s, the recreational use of trampolines has increased dramatically, particularly in North America, Europe and Australia (1). In the United States, backyard trampoline sales exceed 500,000 units annually (1).

Injuries resulting from the use of trampolines have been well documented in the medical literature for the past 50 years (1,2,4-16). Trampoline injuries continue to increase over time (1,15,17-19). One study (1) showed a 98% increase in trampoline injuries between 1990 and 1995. Many of these injuries require hospitalization with or without surgery, and result in permanent morbidity (1,2,4-19). The vast majority of injuries are in the paediatric age group (18-22).

The present position statement reviews injuries sustained by children as a result of the recreational use of home trampolines, including the incidence, types and circumstances of injuries, as well as the disposition of children following injury. A literature review on trampoline injuries between 1966 and April 2006 was performed using MEDLINE. Canadian injury data were provided by the Public Health Agency of Canada. Recommendations regarding the recreational use of home trampolines by children are included. Injuries resulting from the use of trampolines in school physical education programs as part of training or competition for sport such as diving, gymnastics or trampolining, or the use of trampolines under the direct supervision of a therapist for the rehabilitation of an injury are not discussed.

TRAMPOLINE INJURIES

The prevalence of trampoline injuries in the paediatric age group appears to be rising. The main source of data on trampoline injuries in Canada is the Canadian Hospital Injury Reporting and Prevention Program (CHIRPP), a computerized information database that records injuries in patients from 14 emergency departments, including 10 children's hospitals. The Public Health Agency of Canada has published numerous CHIRPP studies that are related to trampoline injuries. Between 1990 and 1998, there was almost a fourfold increase (from 149 in 1990 to 557 in 1998) in the number of injuries sustained by children from trampolines (18). There was also a significant increase in the number of injuries between 1999 and 2003, particularly between 2002 and 2003 (Table 1) (19). This is likely to be an underestimation of trampoline injuries because the database does not capture children with injuries presenting to a doctor's office or a walk-in clinic, or to a hospital not included in the CHIRPP network. Fatal injuries are also under-represented because the CHIRPP database does not capture information on deaths occurring before reaching hospital or after hospitalization (18). The CHIRPP data also do not reflect exposure rates and participation rates. Therefore, the increase in injury rates may be explained by an increase in trampoline utilization.

The severity of trampoline injuries is also concerning. Using hospital admission rates as a measure of injury severity, trampoline injuries result in greater harm than injuries incurred in other sports or recreational activities. In Canada, despite the fact that trampoline injuries occur less often than other sport- and recreation-related injuries, perhaps reflecting lower participation rates, they result in a relatively greater frequency of hospital admissions (S McFaull, personal communication) (Table 2). The CHIRPP data also confirm that between 1990 and 2001, there was a 56% increase in the number of hospital admissions resulting from trampoline-related injuries (19).

Injury type, circumstances and patient disposition

The CHIRPP summary data for 1998 revealed that the majority of trampoline-related injuries occurred in the five- to 14-year age group (78.9%) and most (72.2%) occurred during home recreational use. Fractures were the most common injury (48.6%), often in the upper limb (57.7%), and they accounted for the majority of hospital admissions (86.3%). The overall hospital admission rate was 13.1%, compared with an overall admission rate of 6.8% for the entire CHIRPP database over the same time period. Of admitted patients, 82.2% were in the five- to 14-year age group.

The most recent CHIRPP statistics reported on trampoline injuries between 1999 and 2003 (Table 1) (19). The study included backyard trampolines only – mini, exercise and water trampolines, as well as incidents occurring at gymnastics clubs and schools, were excluded. Youth between 10 and 14 years of age accounted for 43.3% of these injuries, with a median age of 10.1 years. Fractures were most common (47.2%), with 62.5% in the upper

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TABLE 1
Backyard trampoline injuries from the Canadian Hospital Injury Reporting and Prevention Program (CHIRPP) database between 1999 and 2003 for children of all ages

Year	Cases (n)	Cases/100,000 CHIRPP cases
1999	459	450.4
2000	469	441.5
2001	503	473.4
2002	594	549.3
2003	680	639.7
Total	2705	511.5

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Table 2
Frequency of some sports and recreation (SPAR) injuries taken from the Canadian Hospital Injury Reporting and Prevention Program database between 1999 and 2003 for children one year of age and older

Activity	Estimated injuries (n)*	All SPAR (%)	Injuries admitted to hospital (%)
Bicycling	15,945	10.2	10.2
Soccer	14,822	9.5	2.5
Ice hockey	13,759	8.8	3.3
Football	7217	4.6	2.8
Snowboard	6314	4.0	12.0
Ice skating	3802	2.4	3.2
Sledding	3796	2.4	9.4
Alpine skiing	3497	2.2	12.9
Trampoline	2705	1.7	12.4
Overall SPAR	156,717	–	5.3

Reproduced with permission from Steven McFaull, Senior Research Analyst, Injury and Child Maltreatment Section, Health Surveillance and Epidemiology Division, Public Health Agency of Canada.**Based on a search of contributing factor codes; frequencies are estimates based on uncleaned data*

extremities. The hospital admission rate was 12.4%, more than double the admission rate (5.9%) for all injuries in the CHIRPP database for the same time period. Approximately one-half of patients (52.4%) were injured on the trampoline mat, and 14.3% were injured when multiple people were on the trampoline mat at the same time (19).

A regional Canadian study (6) found similar results. Black and Amadeo reviewed orthopedic injuries in children resulting from the recreational use of a trampoline in Winnipeg, Manitoba. The majority of these injuries occurred in children between five and nine years of age (49%). Sixty-five per cent of the children were injured on the trampoline mat, while 30% were injured when they fell off the trampoline mat. Thirty-five per cent of children were injured when there were multiple children on the mat at the same time. The most common injury was a fracture or fracture dislocation (75%), with the upper extremities most often involved (forearm 45%, humerus and elbow 35%). There was one fracture dislocation of the cervical spine with paralysis in an eight-year-old boy who fell off the trampoline mat. There were no reported deaths. Ten per cent of cases occurred under adult supervision (6).

The world perspective

A number of studies from other countries have also reviewed trampoline injuries in children (1,2,4,6,7,13-19,21,22). A review of these papers, including the previously stated Canadian data, is summarized as follows:

Ages most at risk: The majority of trampoline injuries occurred in the five- to 14-year age group, with the average age between seven and 10 years (1,6,7,13-15,17-19,22). This age group also had the most trampoline-related hospital admissions (4,18).

Most common injuries: The majority of studies (1,4,6,13,15,17-19,21,22) found fractures were the most common injury (32% to 75%) and the most frequent reason for hospital admission (1,17,18,21,22). Two small retrospective studies (2,14) found that sprains and strains were the most common trampoline-related injuries.

Most common site of injury: The extremities, especially the upper limbs, were injured in 30% to 80% of cases (1,4,6,7,13,17-19,21,22). Two small retrospective studies (2,14) found that the lower limbs were involved more often.

Circumstances: Most trampoline injuries (71% to 99%) occurred at home or at a neighbour's house (1,2,4,7,15,17,18,21,22). Up to 83% of injuries happened when there was more than one child on the trampoline at the same time (6,7,13,15,17,19). The majority occurred as a result of falling on the trampoline mat (52% to 66%) (6,7,13,15,17,19). With the exception of one study (4), which found that 80% of injuries occurred as a result of falling off the trampoline, falls off the trampoline accounted for 30% or less of injuries (6,7,13,15). Less common circumstances resulting in injury included attempting stunts such as somersaults or flips (7,15,19), and imaginative play such as jumping off a ladder onto the trampoline mat (15). Seasonal injury peaks occurred in the spring and summer months, when backyard trampolines are mostly in use (1,6,7,13,15,18,19,21,22).

Disposition of children: Most children were discharged home following evaluation of their injuries in the emergency department (18,22). Hospital admission rates ranged from 3% to 17% (1,2,7,13-15,17-19,21). One New Zealand study (4) showed an increase in hospital admission rates for trampoline injuries from 3.1 to 9.3 per 100,000 persons per year between 1979 and 1988, with the highest admission rate in the five to nine-year age group (30.3 per 100,000 persons per year). The majority of admissions resulted from fractures (1,6,17,18,21,22), with 6% to 17% of children requiring surgery (7,13,15,17).

Serious injury: There have been reports of rare, but serious, injuries resulting in significant morbidity associated with trampolines, including cervical spine injuries (5,6,8-10,15,16,19), vertebral artery dissection (23), significant knee ligamentous injuries (9,24), popliteal artery thrombosis (25) and ulnar nerve injury (26). Cervical spine injuries

TABLE 3
Policy regarding trampoline use by children

Organization, year (reference)	Position
Health Canada, 2005 (28)	Advises caution with restrictions: adequate supervision; one person at a time; older than six years of age; no ladders; no somersaults; shock-absorbing pads; enclosure netting; trampoline at ground level.
American Academy of Pediatrics, 1999 (17)	Trampolines should not be used at home; parents should never purchase or allow children to use home trampolines. Trampolines should not be in playgrounds, viewed as play equipment or be part of physical education classes. Limited use of trampolines in supervised training programs with use of safety pads, safety harnesses or spotting belts, trampoline mat at ground level, only one person at a time, competent spotters
Safe Kids Canada, 2005 (27)	Adheres to the American Academy of Pediatrics' recommendations.
American Academy of Orthopedic Surgeons, 2005 (29)	Trampolines should not be used for unsupervised recreational activity and never by children younger than six years of age. Adherence to Consumer Product Safety Commission guidelines.
Consumer Product Safety Commission, 2000 (20)	Only one person at a time; no somersaults; shock-absorbing pads covering springs, hooks and frame; placing trampoline away from structures/play areas; no ladders; older than six years of age; supervision at all times; enclosures.
Department of Consumer and Employment Protection, Government of Western Australia/ Kidsafe WA, 2001 (31)	Children younger than six years of age should be supervised at all times; older children should have strict guidelines for use; one person at a time; bounce near centre of mat; step on and off mat; avoid risky manoeuvres.
Victorian Injury Surveillance System, 1992 (21) and 2000 (22)	Trampolines should not be regarded as play equipment; parents not encouraged to purchase backyard trampolines. Ideally trampolining should be done in a supervised setting with trained personnel, using harnesses for difficult manoeuvres. If parents purchase backyard trampolines, they should only be used with strict adult supervision; no somersaults; one person at a time; keep to centre of mat; step on and off mat.

are perhaps the most concerning because of the potential for significant long-term morbidity. One study (15) in children found 12% of injuries were spinal injuries, including seven cervical or thoracic fractures and one with C7 paraplegia. Torg and Das (5,11) and Torg (12) reviewed 114 catastrophic cervical spine injuries resulting in quadriplegia associated with trampolining. The majority of these injuries occurred in highly trained athletes during training sessions, indicating that training with experienced supervision does not prevent these catastrophic injuries (5,9-12).

EXISTING POLICY

Trampolining is a high-risk activity with the potential for significant injury, especially in children and youth. Multiple authors and organizations, including the American Academy of Pediatrics (AAP) and Safe Kids Canada, have called for the elimination of trampolines in the home environment as recreational play equipment (1-4,7,8,14,17,27) or for an outright ban on trampolines under any circumstances for the paediatric age group (5,9-12,15,16) (Table 3). Others, including Health Canada and the American Academy of Orthopedic Surgeons, have advocated for specific paediatric limitations, including no participation by children younger than six years of age, only one child on the trampoline mat at a time, parental supervision and no flips or tricks while on the trampoline (6,7,13,21,22,28-31).

Regarding the limited use of trampolines in supervised competitive training programs, such as trampolining, diving and gymnastics, the AAP (17) and the Victorian Injury Surveillance System (21,22) have recommended that the following safety measures be strictly adhered to: the use of safety pads covering the frame and springs of the trampoline, as well as the surface surrounding the trampoline; the presence of competent spotters trained in trampoline safety at all times when the trampoline is in use; only one person on the trampoline at a time at the centre of the mat; avoidance of manoeuvres beyond the athlete's skill level; and the use of safety harnesses when learning or practicing more advanced skills.

Despite these safety recommendations, significant trampoline-related injuries in children continue to occur. For instance, in Australia, despite the existence of clear recommendations for the safe use of trampolines since 1992 (21), there were 1355 trampoline-related injuries in children younger than 15 years of age presenting to emergency departments in Victoria between 1995 and 1999, 16% of whom required hospital admission (22).

CONCLUSIONS

Trampoline injuries occur frequently in the paediatric age group. The majority of injuries and hospital admissions occur in the five- to 14-year age group. There has been an alarming increase in the rate of hospital admissions in Canada resulting from trampoline-related injuries, mostly for fractures of the upper extremities. The majority of trampoline injuries occur on backyard trampolines as a result of falls on the trampoline mat, negating the notion that spotters around

the outside of the trampoline, parental supervision or even safety enclosures can eliminate injuries. Many injuries occur when there are multiple users on the trampoline at the same time and when there is inadequate supervision.

Numerous authors and organizations, such as the AAP, have made recommendations against the use of trampolines by children. Other organizations, such as the American Academy of Orthopedic Surgeons, Health Canada and the Consumer Product Safety Commission have recommended specific restrictions on the use of trampolines in the paediatric age group. Despite these warnings, however, trampoline injury rates continue to rise.

RECOMMENDATIONS

The use of trampolines is a high-risk activity with the potential for serious injury. The rapid increase in injuries related to the recreational use of trampolines by children is evidence that current preventive strategies are ineffective to prevent the majority of injuries. Therefore, the Canadian Paediatric Society and the Canadian Academy of Sport Medicine recommend that:

- Trampolines should not be used for recreational purposes at home (including cottages and temporary summer residences) by children or adolescents.
- Health care professionals, including family physicians and paediatricians, should warn parents of the dangers of trampolines as a recreational toy at routine health care visits. Parents should be advised to avoid the purchase of trampolines for the home because enclosures and adequate supervision are no guarantee against injury.
- Trampolines should not be regarded as play equipment and should not be part of outdoor playgrounds.
- Physicians should advocate for legislation to require warnings of trampoline dangers to be put on product labels.
- More research on trampoline injuries sustained in supervised settings, such as schools, gym clubs and training programs, should be conducted to assess the risk of injury in these settings.

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The recommendations in this statement do not indicate an exclusive course of treatment or procedure to be followed. Variations, taking into account individual circumstances, may be appropriate. <*Internet addresses are current at time of publication*>

CPSP HIGHLIGHTS

Transdermal contraceptive patch: Safe or risky treatment?

A 15-year-old girl started a low-dose oral contraceptive three months previously. She comes back for follow-up wanting her contraception to be changed to a skin patch because she has a hard time remembering to take the daily oral contraceptive medication. On further questioning, you document that she has a regular partner and that they do not always use a condom. However, her menstrual period started two days previously. You counsel her on the risk of sexually transmitted infections and on the importance of protection. She also admits to being a regular cigarette smoker (six to eight cigarettes per day), and denies any headache and family history of stroke or thrombophlebitis.

On physical examination, her height is 160 cm (10th percentile) and her weight is 80 kg (greater than the 95th percentile), with a calculated body mass index of 31.2 kg/m^2 (greater than the 95th percentile) and predominantly more body fat distributed in the abdominal area. Her blood pressure is 130/70 mmHg. You perform a gynecological examination that is normal and you confirm negative vaginal cultures, Pap smear and pregnancy tests. A urine dipstick test is also negative. You appropriately change her medication to a transdermal contraceptive system containing 6.0 mg of norelgestromin and 0.60 mg of ethinyl estradiol, and arrange a follow-up visit to see her in one-month.

Three weeks later, you learn that she was involved in a motorcycle accident, immobilized with a femur fracture and taken off the patch. She then suffered a deep vein thrombophlebitis requiring heparinization. Further investigations revealed that she was a carrier of a factor V Leiden mutation.

LEARNING POINTS

- Transdermal contraceptive systems are popular, effective and convenient because they are applied once a week and associated with better compliance, especially in adolescents.
- All estrogen/progesterone combination contraceptives carry a risk of thrombophlebitis and thromboembolitic disease (TED) with the majority of the risk attributable to the estrogen component.
- The risk of venous thromboembolism in users of the oral contraceptive pill (OCP) is up to four times higher than in age-matched nonusers, but is still lower than the risk of TED in pregnancy, which is 13 times higher.
- Other risk factors to be considered include a family history or a personal history of TED, or thrombophilia, obesity, smoking, prolonged immobilization and a factor V Leiden mutation.
- Although cases of stroke and death have been reported in young, otherwise healthy women on oral hormonal contraception or in those using a transdermal contraceptive system, in the absence of a personal or family history of TED, universal laboratory screening for procoagulant conditions before OCP use is not recommended or deemed economically justified.
- Intersubject variability for the pharmacokinetic parameters following delivery from a transdermal contraceptive system can expose women to higher levels of estrogens than most birth control pills, and can theoretically carry a greater risk of venous thromboembolism.
- The Canadian transdermal contraceptive patch is different than the American product with a lower estrogen content and, over the 21-day period of use, had a comparable dose of estrogen to an OCP in a comparable category.
- Women who have experienced a thromboembolitic event are candidates for a progestin-only method of contraception, such as depot medroxyprogesterone acetate.
- Research is needed to document the average daily amount of hormones released by different transdermal contraceptive systems, and further postmarketing surveillance is needed to document associated adverse events.

The Canadian Paediatric Surveillance Program (CPSP) is a project of the Canadian Paediatric Society, which undertakes the surveillance of rare diseases and conditions in children. For more information, visit our Web site at <www.cps.ca/cpsp> or <www.cps.ca/pcsp>. Accepted for publication July 11, 2007