

Paediatric injury from indoor trampoline centres

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Received 17 April 2016

Revised 26 June 2016

Accepted 6 July 2016

ABSTRACT

Indoor trampoline parks are increasing as a source of injuries among children. We conducted a prospective cohort study, with semi-structured interview and medical record review, of children aged <17 years presenting to a paediatric emergency department following an injury at an indoor trampoline park. In a 6-month period in 2014, 40 such children (55% female) presented to the department. Common mechanisms were individual jumpers falling while attempting a somersault or trick, landing awkwardly on an obstacle such as a ball or protective padding, and multiple users on a single trampoline. Most sustained soft tissue injuries (n=22, 55%) and fractured bones (n=15, 37.5%). One child sustained an unstable cervical fracture/dislocation. Unlike domestic trampolines, where the majority of injuries occur from falling off, most trampoline-park injuries occur on the trampoline surface. These differences require injury prevention strategies that engage children, carers and businesses to meet best practice design and management standards.

INTRODUCTION

Trampolines are popular among children and young people, but can pose a significant risk for injury.¹⁻³ The American Academy of Pediatrics and the American Association of Orthopedic Surgeons have warned against the use of trampolines for children under 6 years.²⁻⁴ In Australia, there has been a recent rise in the prevalence and popularity of commercial indoor trampoline parks with over 20 new centres opening in the last 3 years, and an estimated 3 new facilities opening every month.⁵

These venues offer a different user experience as compared with domestic trampolines, with open-plan areas comprising multiple adjoining trampolines. Most trampoline parks also offer dedicated areas such as foam pits into which users can perform somersaults and tricks, as well as trampolines built on angles and onto walls allowing users to increase their lateral as well as vertical travel. Many centres offer fitness classes and team games such as 'dodge-ball' on the open-plan areas.

Public health and prevention initiatives in Australia, and elsewhere, have largely focused on domestic home trampolines, including education campaigns and the development of a voluntary national standards for trampoline design and manufacturing (Australian Standard 4989-2015, American Standard ASTM F24.60).⁶⁻⁷ This standard includes requirements pertaining to spring and frame padding design, protection of sharp edges, safety marking and labelling and consumer information. It does not extend to cover commercial trampoline parks, although some operators and public health stakeholders are advocating the

development of a new Australian Standard, informed in part by an industry-led code of practice.⁸

There have been concerns raised in the media and medical community regarding the safety of such centres and reports of an anecdotal rise in number of young people being injured, with reports of deaths in similar centres in the USA.⁵⁻⁹⁻¹¹ However, there are no published data on the unique injury mechanistic factors or patterns seen. Given that trampolines in these parks are designed, built and used in different ways as compared with domestic trampolines, it is likely that both the nature and mechanism may vary between these injury sources.

Our aim was to examine the patterns of injury and injury mechanisms among children injured while using commercial trampoline centres. Through this, we hope to inform injury prevention measures relevant to the design and management of these parks.

MATERIALS AND METHODS

We conducted a prospective cohort study of patients presenting with injuries sustained from indoor trampoline centres to Sydney Children's Hospital, a level 1 paediatric trauma centre with approximately 37 000 emergency department presentations per annum. The closest indoor trampoline centre in the hospital catchment area is located 5.8 km away and opened in July 2014.

Patients were eligible for inclusion in the study if they were aged 16 years, or under, and the principal reason for their presentation to hospital was an injury sustained at an indoor trampoline centre. Patients were identified prospectively by staff in the emergency department and outpatient fracture clinics. Additional patients were identified retrospectively through emergency department databases identifying the cause of the presentation as sustained at a trampoline park. Data were collected over a 6-month period from July 2014 to January 2015. Once identified, medical records were reviewed and a semi-structured interview focusing on the mechanism and circumstances of injury was conducted with each patient or their parent or guardian. Approval was granted by the hospital's Human Research Ethics Committee. Data were analysed using SPSS Version 23 (IBM, 2014). Descriptive statistics were calculated for all response variables.

RESULTS

Results are summarised in [table 1](#). During the 6-month study period, 40 patients presented from indoor trampoline parks, including 18 males (45%) and 22 females (55%). All patients presented from a single trampoline centre in the hospital's

To cite: Mulligan CS, Adams S, Brown J. *Inj Prev* Published Online First: [please include Day Month Year] doi:10.1136/injuryprev-2016-042071

Table 1 Summary of results

Gender	
Male	18 (45%)
Female	22 (55%)
Age	
10.4 (years, mean)	1–16 (years, range)
Weight	
39.9 (kg, mean)	13–75 (years, range)
Injury type	
Fracture/dislocation	15 (37.5%)
Sprain	22 (55%)
Laceration	1 (2.5%)
Other	2 (5%)
Injury location	
Head/neck	4 (10%)
Upper extremity	6 (15%)
Lower extremity	27 (67.5%)
Torso	3 (7.5%)
Trapolining type	
Single jumper	23 (57.5%)
Multiple jumper	8 (20%)
Dismounting	2 (5%)
Off trampoline	1 (2.5%)
Unknown	6 (15%)
Preceding mechanism	
Attempted somersault	5 (12.5%)
Simple jumping	21 (52.5%)
Fell from trampoline	1 (2.5%)
Struck ball/springs/caught in mat	6 (15%)
Off trampoline/unknown	7 (17.5%)

catchment area. The average age of the patients was 10.4 years (range 1–16 years), and the average weight was 39.9 kg (range 13–75 kg).

Injuries most commonly occurred when the child was bouncing on a trampoline alone (23 of 33 cases, or two-thirds, for which there were qualitative mechanistic data). Mostly this type of injury was the result of a failed landing ($n=18$). The second most common situation involved multiple concurrent users of a single trampoline (8 of 33 cases). Most of these ($n=7$) occurred when the smaller of the two (or more) users fell as a result of the increased energy transferred from the larger bouncer, resulting in a mistimed landing or being projected to an unexpected height or distance. In one case, a child was injured through a direct collision. Two children were injured from falls while dismounting, and one child sustained injury from a standing height trip over an obstacle in a holding bay area.

Most children were injured while involved in simple jumping activities (52.5%). However, five children (12.5%) were injured while attempting somersaults or flips. Six children were injured when they came into contact with something while on the trampoline. This included two children who landed on balls, and four children who landed on, or caught their feet in, the less elastic padding surrounding them or the hard surface floor.

In terms of the injuries observed, the majority of patients presented with a soft tissue injury or sprain ($n=22$, 55%) or fractured bone(s) ($n=15$, 37.5%). One child sustained a lip laceration. One child presented with concussion, and one with chest pain. The lower extremity was the most frequent site of injury (67.5%), followed by the upper extremity (15%). The

most common sprains were of the ankle ($n=13$). The most common fractures were supracondylar fractures of the elbow ($n=4$) and fractures of the ankle ($n=4$). There was one fracture/dislocation of a cervical vertebra. No patients sustained a loss of consciousness.

The rate of admission in this cohort was 12.5% ($n=5$), which is similar to the rate of admission of injuries sustained from domestic trampolines over the same period ($n=17$, 12.2%). The operations performed for the admitted patients included the operative fixation of three forearm fractures, an anterior cervical discectomy and fusion and a knee arthroscopy.

DISCUSSION

The rise in popularity of trampoline parks has seen a corresponding rise in the number of injuries. While most of the injuries presented in our cohort are minor, they range in severity, with over 12% requiring operative intervention. Domestic trampolines at home (rather than those at schools or community centres) were identified as the most appropriate comparator, as in the Australian context as they are by far the most popular trampoline type. Although they have similar rates of admission (at approximately 12%) and patterns of injury at our institution, there are some key differences in injury mechanisms suggesting that different approaches to prevention are required.

The clearest differences are in the design and layout of the trampolines themselves. Trampolines in centres are generally not raised off the ground but built into it, meaning that it is not possible to ‘fall off’ the trampoline, while this is the most common mechanism of injury in home trampolines.¹ Furthermore, the spring mechanisms are generally protected by padding, meaning that it is not possible to fall through them as compared with some old-style home trampolines. However, four patients in our cohort were injured after their feet were caught in this protective padding, which suggests further improvements in equipment design may be desirable.

In our cohort, double bouncing, or multiple users on a single trampoline, carried a significant risk for injury. This occurred particularly when small children were jumping with larger peers or other adults. Where there is a mismatch in the mass of the individuals, the forces transferred from the larger person to the smaller one can be amplified, effectively increasing the height of a fall.¹² An important aspect of ‘safe bouncing’ is therefore ensuring that double bouncing does not occur. While most operators prohibit double bouncing, our data illustrate that this remains a common hazard for home and commercial trampolines.^{6 13}

Other issues that warrant further investigation are the risk-taking and behavioural differences of children in large groups, who may visit trampoline parks (eg, for a birthday party or school trip) without direct parental supervision, compared with domestic trampolines.

This study is limited in its small sample size and potential bias of more severe injuries presenting to our tertiary trauma centre. A referral bias is possible, as all cases were from a single nearby, franchised, park. The self-reported and post hoc medical record data did not allow us to definitively explore the causal links between fall mechanism and injury pattern.

The study nonetheless demonstrates generalisable messages on potentially unique injury mechanisms at indoor trampoline centres and highlights an important emerging public health issue. Our series suggest that further injury prevention strategies are warranted. In conjunction with workplace safety regulators, business operators and engineers, we are working towards the

adoption of a new uniform national standard for commercial trampoline parks and also directly with centre operators to more accurately identify contributory factors and potential countermeasures to injury.

What is already known on the subject

- ▶ Indoor trampoline parks are an increasingly popular form of recreation, particularly among children and young people.
- ▶ There are increasing numbers of injuries, and even fatalities, reported from these centres, though it is not known if or how these differ from injuries sustained on home trampolines.

What this study adds

- ▶ This study highlights an emerging public health concern of injuries sustained at indoor trampoline parks.
- ▶ This series characterises a cohort of children injured at indoor trampoline parks, describing the injury patterns and mechanism of injury that differ from injuries on domestic trampolines.

Acknowledgements The authors wish to thank Ms Marijke Oomens from Neuroscience Research Australia, Miss Alicia Miers, Ms Sarah Adams and Dr Kathryn Blurton from the Sydney Children's Hospital for their assistance in data acquisition.

Contributors CSM and SA designed the study. CSM performed data collection and analysis. CSM and JB drafted the manuscript. CSM, JB and SA reviewed the manuscript and approved it in its final form.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

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