



## Trampoline related injuries in adults



Varun Arora<sup>a</sup>, Lara A. Kimmel<sup>b,c</sup>, Kathy Yu<sup>d,e</sup>, Belinda J. Gabbe<sup>c</sup>, Susan M. Liew<sup>a,f</sup>, Afshin Kamali Moaveni<sup>a,f,\*</sup>

<sup>a</sup> Department of Orthopaedic Surgery, The Alfred Hospital, Melbourne, Australia

<sup>b</sup> Department of Physiotherapy, Alfred Hospital, Melbourne, Australia

<sup>c</sup> Department of Epidemiology and Preventive Medicine, Monash University, Victoria, Australia

<sup>d</sup> Gymnastics Australia, Australia

<sup>e</sup> The Melbourne Sports Medicine Centre, Australia

<sup>f</sup> Department of Surgery, Monash University, Melbourne, Australia

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### ABSTRACT

**Introduction:** Trampoline-related injuries in adults are uncommon. Participation in trampolining is increasing following its admission as a sport in the Olympics and the opening of local recreational trampoline centres. The aim of this study was to assess the number and outcomes of adult trampoline-related orthopaedic injuries presenting to four trauma hospitals in Victoria.

**Methods:** A cohort study was performed for the period 2007–2013. Adult patients registered by the Victorian Orthopaedic Trauma Outcomes Registry (VOTOR) who had sustained a trampolining related injury were included in this study. Descriptive analyses were used to describe the patient population, the injuries sustained and their in-hospital and 6-month outcomes.

**Results:** There was an increase in trampolining injuries from 2007 ( $n = 3$ ) to 2012 ( $n = 14$ ) and 2013 ( $n = 18$ ). Overall, fifty patients with a median age of 25 (range 16–66) were identified. Thirty-five patients (70%) had lower limb injuries, 20 patients (40%) had spinal injuries and one patient had an upper limb injury. Thirty-nine patients (78%) required surgery. Fractures of the tibia ( $n = 13$ ), ankle fractures ( $n = 12$ ) and cervical spine injuries ( $n = 7$ ) were the most common injuries; all of which required surgery. Complications included death, spinal cord injuries, compartment syndrome and open fractures. At 6 months post injury, more than half (52%) of the patients had not achieved a good recovery, 32% had some form of persistent disability, 14% did not get back to work and overall physical health for the cohort was well below population norms for the SF-12.

**Conclusion:** Adult trampoline-related injuries have increased in the last few years in this cohort identified through VOTOR. Lower limb and spinal injuries are most prevalent. Public awareness and education are important to reduce the risk for people participating in this activity.

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## Introduction

Trampoline-related injuries are common in the pediatric population, with the aetiology, type of injuries and outcomes well described [1–6]. Less is known about trampoline related injuries in adults where the literature is limited to a few case reports and one case-series [7–12]. The seriousness of trampoline-related injuries has prompted the American Academy of Orthopaedic Surgeons

(AAOS) and the American Academy of Pediatrics (AAP) to issue multiple advisories to parents against the use of trampolines in the home environment, routine physical education classes, outdoor playgrounds or for recreational use [13,14].

With the introduction of trampolining as a sport in the Olympic Games and the recent popularity of commercial recreational trampoline centres, there is an opportunity to review trampoline-related serious orthopaedic injuries and analyse their outcomes in the adult population.

The aims of this study were to (i) report the number, type and management of trampoline related injuries, and (ii) to review the six-month patient reported outcomes, for adults presenting to four trauma hospitals in Victoria, Australia between 2007 and 2013.

\* Corresponding author at: 48/166 Gipps Street, East Melbourne VIC 3002, Australia. Tel.: +61 3 9416 1466.

E-mail address: [ash@moaveni.com.au](mailto:ash@moaveni.com.au) (A. Kamali Moaveni).

## Methods

### Study design

A retrospective cohort study was performed for the period 2007–2013. Patients were identified through the Victorian Orthopaedic Trauma Outcomes Registry (VOTOR). This registry is a comprehensive database of orthopaedic injuries, treatment, complications and outcomes based on admissions to the two adult Major Trauma Service (MTS) hospitals in Victoria (Royal Melbourne Hospital and The Alfred Hospital), and the Geelong and Northern Hospitals. The methodology for VOTOR data collection is well established [15]. All patients admitted to the participating hospitals for greater than 24 h with an orthopaedic and/or spinal injury are eligible for inclusion on the VOTOR registry. Patients with a pathological fracture related to metastatic disease are excluded. An opt-out method of consent is used.

Ethical approval for VOTOR has been obtained from the Human Research Ethics Committees (HREC) of the participating institutions. Additionally, ethics approval from the Alfred health HREC was granted specifically for this project.

### Patients

Patients were included in this study if they were registered by VOTOR, were aged 16 years or older (at the time of injury) and had sustained a trampoline-related injury. Trampoline-related injuries were identified using the following Chapter XX external cause and activity ICD-10-AM codes: (i) U5706 – Gymnastics (Trampoline or Mini Trampoline) (ii) W096 – Fall from trampoline (iii) Y9344–Trampolining.

### Data

Patient demographics, injury diagnoses, management and patient reported outcomes at six months were extracted from the VOTOR database. The injury diagnosis and management data were classified according to the ICD-10-AM coding system.

### Outcome measures

All outcome data were collected prospectively by VOTOR as part of the registry's routine protocols. Standardised telephone interviews by trained registry staff at 6 months post injury [16] collected the following patient reported outcomes of interest:

- (i) The Glasgow Outcome Score – Extended (GOS-E) – GOSE-E provides a measure of function on a scale from death (GOS-E = 1) to upper good recovery (GOS-E = 8) and considers aspects such as self-care, mobility, social and leisure activities. It has been recommended for use by trauma registries to monitor functional outcomes [17]. The GOS-E score was categorised into less than a good recovery (GOS-E 1–6) and good recovery (GOS-E 7 or 8) [18], with a good recovery essentially representing return to pre-injury functional levels with minimal sequelae related to their injury.
- (ii) Self reported disability at baseline and at 6 months. This item describes the level of disability a patient reported during the week prior to the injury event, and the level of disability the patient reported during the week prior to their 6 month telephone interview [19]. Disability was reported on a five point Likert-type scale as none, mild, moderate, marked or severe.
- (iii) The SF-12 is a measure of health status which been validated for use within the Australian population and trauma patients [20]. Responses to the items of the SF-12 are converted into a

physical component summary (PCS-12) score and a mental component summary (MCS-12) score to describe the physical and mental health status of a patient.

- (iv) Pain was measured using a numeric rating scale (NRS) ranging from zero (no pain at all) to 10 (worst possible pain) [21]. Pain was categorised as the presence (NRS  $\geq$  5) or absence of moderate-severe persistent pain (NRS < 5) at 6 months post-injury.
- (v) Return to work (RTW) provides a representation of the financial and social burden of trauma and a measure of post-injury function and was described as a proportion of those working at 6 months post injury (if they were working prior to injury).

### Data analysis

Statistical analyses were performed using Stata software (release 12.2; Stata Corp, College Station, TX) and SPSS (version 15.0). Mean values and standard deviations were reported for normally distributed continuous data, and median values and interquartile ranges were reported for continuous data that were not normally distributed. Categorical data was reported using percentages. To compare the PCS-12 and MCS-12 scores to Australian population norms, standardised mean differences (or Cohen's D) was used. The standardised mean difference (SMD) acts to standardise individual scores by age and gender to provide a method of showing the degree of deviation from the population norm. The size of the SMD compares the magnitude of difference between the SF-12 scores of our population and that of the Australian population norms, with values greater than 0.8 considered large.

## Results

### Overview of patients

Fifty adult patients with trampoline-related injuries were identified using the VOTOR database between 2007 and 2013. The number of trampolining injuries in adults captured by VOTOR rose from three in 2007 to 16 in 2012 and 18 in 2013. Sixty-eight per cent of the patients identified in this study presented within the last two years (2012 and 2013) (Fig. 1). The majority of the patients (67%) were admitted to The Alfred hospital. Details of the patient profile of trampoline-related injuries in adults presenting to VOTOR hospitals between 2007 and 2013 are presented in Table 1.

### Patient injuries and procedures

Fifty patients sustained 68 fractures. Trauma to the lower limb and spine accounted for the majority of injuries sustained. There were 35 patients with fractures to the lower limb and 20 patients with fractures of the spine. Multiple spinal fractures in the same patient were common. Thirty-eight patients (76%) required surgery. The median length of stay was four days, (range 1–20 days, interquartile range 3–5 days). The specific injuries sustained are shown in Table 2.

### Lower limb injuries

Fractures of the tibia occurred in 13 patients and was the most common diagnosis overall. Ankle fracture was the next most common injury, sustained by 12 patients. All of the ankle and tibia fractures required surgery. Other lower limb injuries included fractures of the femur, mid foot, talus and metatarsals. Six of the

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