Annex 1

Task 1 – Supporting evidence

Index

1. Introduction

Trampolines are a common source of paediatric injury. Additionally, trampoline parks are becoming an increasingly popular venue and the numbers of trampoline parks are increasing in Europe and many other countries.

Playgrounds and other recreational equipment must be safe for children. ANEC participates in the standardisation work for playground equipment (where bouncing facilities are included, activity toys (namely, domestic trampolines), playing field and gymnastic equipment (where gymnastic trampolines are included) and trampoline parks, focusing on terminology, requirements for safety, fitness for purpose, test methods, marking, installation and maintenance, surfacing and accessibility.

Because of this broader representation on Technical Committees that cover standardization on trampolines ANEC decided to launch a technical study in 2019 on the reasons for these accidents and to undertake a gap-analysis of the requirements of the standards for trampolines.

This report answers to Task 1 of the Technical Study on the Epidemiology of Trampoline Injuries and answers, through literature review and analysis of data from the European Injury Database (EU-IDB) to a set of questions regarding trampoline injuries from an epidemiological perspective in terms of number of injuries, incidence, trends in recent years, type and severity of injuries and risks factors associated with injuries.

With this we aim to better understand risk associated with trampoline injuries in different settings allowing to grasp magnitude of the problem and generate hypothesis on drivers of risk for further exploring in different Tasks of this work with the final aim of generating recommendations to improve trampoline safety in Europe, both domestic, gymnastic, playground and in trampoline parks.

2. Aim of Task 1 of ANEC Technical Study

This chapter of the report answers to Task 1 of the Technical Study on the Epidemiology of Trampoline Injuries and answers through literature review and analysis of data from the European Injury Database (EU-IDB)

The Aim of Task 1 of ANEC Technical Study is to "Research reported accidents within the past 10 years, to understand associations and specific products and situations involved, as well as the trends in trampoline use linked to injuries."

3. Methodology

Following the contract agreement, we answered the following questions through a Summary of Findings for each question.

3.1. Questions

Purpose I : "Research reported accidents"

1. Do we observe an increase in trampoline injuries?
2. What are the main injury mechanisms due to trampolines?
3. Are there any age groups among children at higher risk? In terms of:
   - 3.1. injury frequency
   - 3.2. injury severity (e.g. based on hospitalization rate)
   - 3.3. injury mechanism
4. What are the major injury locations (part of the body) due to trampolines?
5. Trampoline use (one vs. more persons)
6. Trampoline size (small vs. larger trampolines)

Purpose II : "Trampoline injuries in trampoline parks"

7. Do we observe an increase in trampoline parks injuries?
8. What are the main injury mechanisms due to trampolines in trampoline parks?
9. Are there any age groups among children at higher risk in trampoline parks? In terms of:
   9.1. injury pattern
   9.2. injury severity (e.g. based on hospitalization rate)
10. Are there any risk differences between trampoline parks and other locations where children are jumping on trampolines?

3.2. Supporting Evidence

For each question of the Task we present two components of evidence:

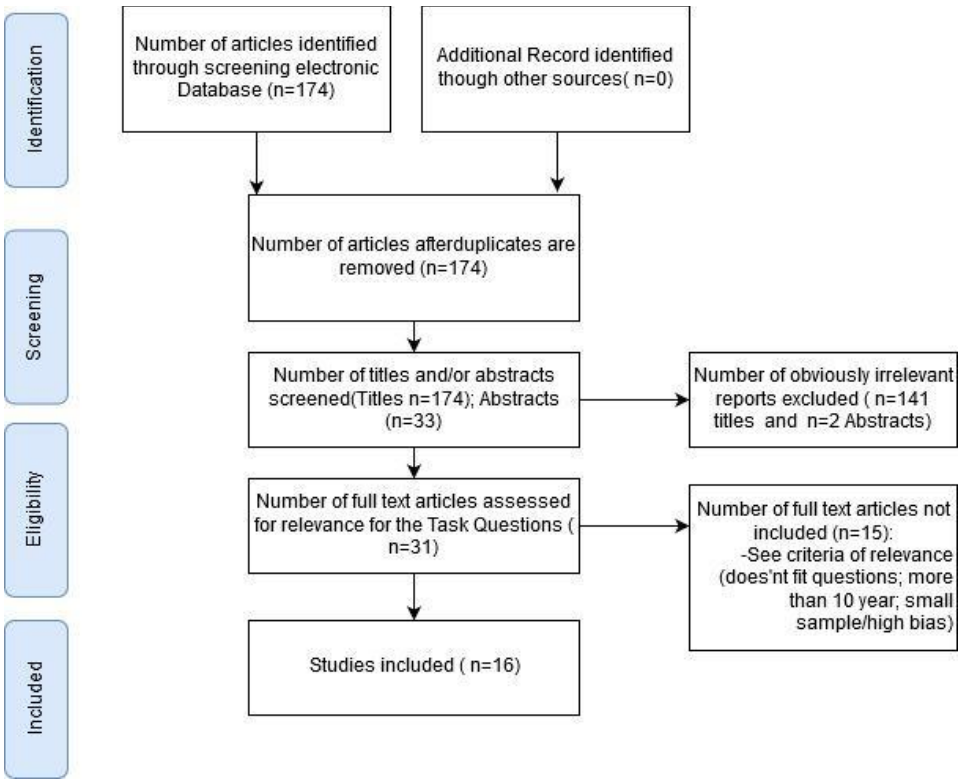
1. Literature Review answering specific questions
   a. We used a PubMed search strategy and recovered all articles that could answer to each question of the task. Articles were included in the report when the task team agreed on relevance to answer specific questions considering, external and internal validity, and adequacy to the specific questions of the Task. Studies using large datasets and registries were given priority and studies from the last 10 years as requested in the Task.
   b. PubMed Search Strategy : trampoline[All Fields] AND ("wounds and injuries"[MeSH Terms] OR ("wounds"[All Fields] AND "injuries"[All Fields]) OR "wounds and injuries"[All Fields] OR "injury"[All Fields])
   c. Grey literature was searched through web browser searching for relevant keywords for each question.

2. Analysis and brief interpretation of the EU Injury Database from 2013-2016 (All episodes registered in the database where a Trampoline was involved from

individuals aged 0 to 18 years old: this age category accounts for more than 90% of all injuries [1]) . Data was kindly shared by Gabriele Ellsäßer. EU-IDB purpose and methods can be found here(https://ec.europa.eu/health/indicators_data/idb/purpose_methods_en). Limitation can be seen bellow and for each question.

a. Statistical analysis included coding and aggregating categories. We present the analysis considering 95%CI and a statistical significance of 0,05. Specific analysis methods are further explained along the report. Chi-square test was used to compare proportions and calculate respective p-value.
b. Relevant Limitations for the interpretation of the results
    i. External validity - Data is limited to reporting hospitals. Most reported injuries were reported from the Netherlands. As such although data can be used to describe injuries characteristics and associations with different selected outcomes it is not useful at this point for estimates of burden or trend analysis in Europe.
    ii. Information Bias - Coding of several variables may be unclear for notifiers. Some codes seem redundant in this context. High proportion of unspecified Places of Occurrence (78%) and no registry of Home as the Place of occurrence. Place of occurrence may be differentially filled if an injury occurred at home or in a Trampoline Park or other public place.

Figure 1 - Flowchart for the selection of relevant studies to Task 1



We also present further analysis of the EU-IDB database and further evidence on topics of relevance that go beyond the contract specific questions.

4. Results

I. Purpose: "Research reported accidents"

1. Do we observe an increase in trampoline injuries?

Ref 1,2,3,4,5,6,7,8,9

- **Summary of findings**

In most selected studies (priority was given to studies with larger and better quality, more representative datasets) there is an increase in trampoline injuries. Limitations of the data must be considered separately for different studies. Real numbers of trampoline injuries are probably higher than those reported because surveillance system sensitivity may be low in most settings.

Different studies report different measurements of trends and incidences.

It is possible that the rise in trampoline injury reports is due to the increasing in number of trampoline use (home trampoline, public parks, and trampoline parks). However, improving reporting practices, change in patterns of use of trampolines and changes in equipment's risk must be considered.

Studies that measure change in Home Trampoline and Trampoline Park Injuries show that the rise is in part due to the rise in Trampoline Park Injuries. This has been reported as the fastest growing category of Trampoline Injuries.

More recent data then 2017 was not found from the literature research. It is likely that as the number and popularity of Trampoline Parks increase, injuries will increase if safety measures or adequate risk communication are not put in place.

Overall, Trampoline injuries are increasing. A relevant proportion of this growth seems to be attributable to wider use of Trampoline Parks. Proportion of Injuries in Trampoline Parks and Home Trampolines vary.

Table 1 Selected Studies for Question 1. and findings related to trends in trampoline injuries

Country	Data Source	Time Frame	Type of injury	Change in incidence/trend
USA	National Electronic Injury Surveillance System (NEISS)	2008 and 2017	All emergency visits	35.3 per 100 000 person-years in 2008 to 53.0 per 100 000 person-year
USA	National Electronic Injury Surveillance System (NEISS)	2010 to 2014	All emergency visits	From 2010 to 2014, the injury rate held constant after general increase trend
Canada	the Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP)	2012 to 2016	All emergency visits	Increasing cases per 100000 CHIRP cases
Canada	the Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP)	2001 to 2015	All emergency visits	Increasing (16 per 1000 CHIRP Injuries)
Finland	Population Based Prospective Study of a Single Region	2015 to 2017	Severe injury only	6.28/100,000 children
Australia	National Hospital Morbidity data	2002 to 2011	Injuries Admitted to Hospital	Increasing (highest in the 5–9 age group 58 per 100000)
USA	National Electronic Injury Surveillance System (NEISS)	2010 to 2014	All emergency visits	Estimated US emergency department visits for TPI increased significantly, from 581 in 2010 to 6932 in 2014 (P = .045), whereas HTIs did not increase (P = .13).
Korea	prospective nationwide databases	2011-2016	All emergency visits	Increased steadily mainly Trampoline Parks Injuries
Korea	nationwide-sample(Korean National Health Insurance Sharing Service) and single-institutional data	2006-2015	All emergency visits	Incidence of injuries increased

- **Literature Review**

Hadley-Miller N, Carry PM, Brazell CJ, Holmes KS, Georgopoulos G. Trends in Trampoline Fractures: 2008–2017. Pediatrics. December 2019

A study in the US with data from The National Electronic Injury Surveillance System found that between 2008 and 2017, there was a 3.85% (95% confidence interval [CI]: 0.51-7.30) increase in the incidence of trampoline-related paediatric fractures per person-year. The incidence of paediatric trampoline-related fractures increased from 35.3 per 100 000 person-years in 2008 to 53.0 per 100 000 person-years in 2017. There was no change in the odds of a trampoline fracture requiring hospitalization (odds ratio per 1 year: 1.02; 95% CI: 0 6-1.07; P = .5431). There was a significant increase in the odds of a fracture occurring at a place of recreation or sport (odds ratio per year: 1.32; 95% CI: 1.21-1.43; P < .0001).[1]

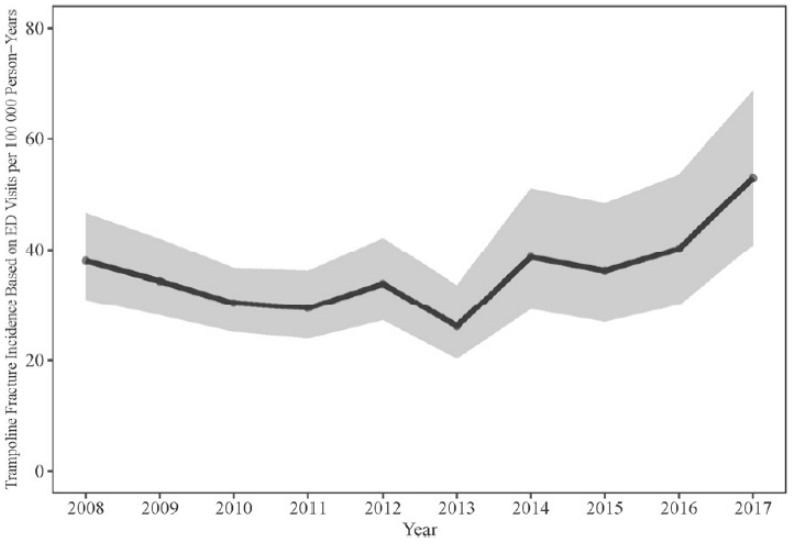


FIGURE 3
Incidence of trampoline fractures: 2008–2017. Incidence of pediatric trampoline fractures presenting to EDs in the United States between 2008 and 2017 is shown. Numerator data were obtained from NEISS by using nationally representative frequency estimates. Denominator data were obtained from US census estimates among individuals in the United States <18 years of age.

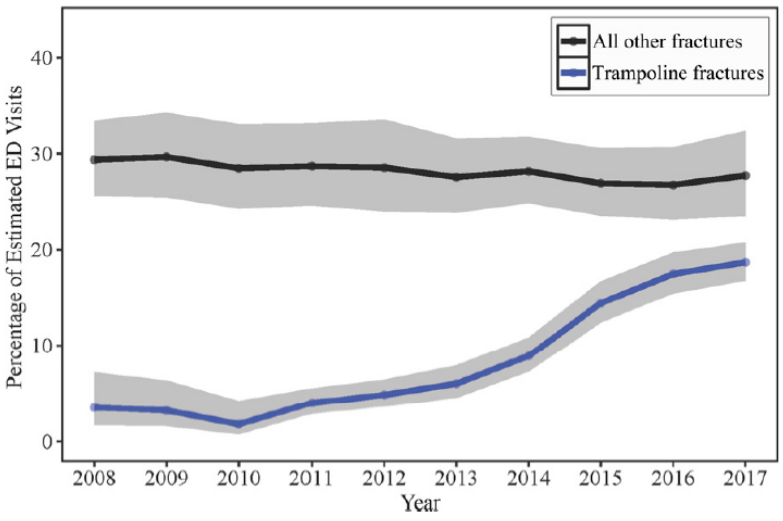


FIGURE 4
Percentage of fractures that occurred at a sports-related location: trampoline-related fractures versus all other fractures. Highlighted is the differential shift in the proportion of pediatric fractures coded as occurring at a sports-related location among trampoline fractures compared with all other fractures. Represented by the interaction analysis, the yearly increase in the proportion of

Karkenny AJ, Burton DA, Maguire KJ, Hanstein R, Otsuka NY. Do Professional Society Advocacy Campaigns Have an Impact on Pediatric Orthopaedic Injuries? J Pediatr Orthop. 2018

A retrospective review of fractures associated with trampolines, lawnmowers, and ATVs among patients aged 2 to 18 years from 1991 to 2014 was performed using the National Electronic Injury Surveillance System (NEISS). Fracture rates and percent changes year-to-year were calculated. From 2010 to 2014, the injury rate held constant during which time 2010, 2013, and 2014 statements were published. A 25% drop from 2007 to 2008 coincided with an AAOS statement in 2008. Fracture rates further dropped 31% from 2009 to 2011 and 21% from 2012 to 2014, amidst 2012 and 2014 statements. For ATV-related and lawnmower-related injuries, more male individuals were affected than female individuals, and for ATVs alone, injury rates increased with age.[2]

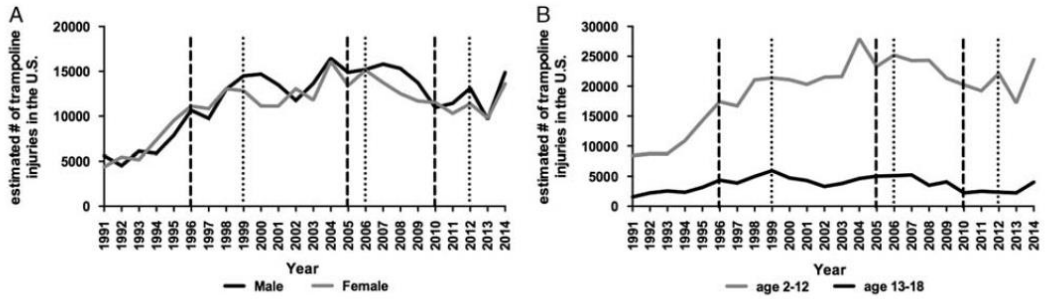
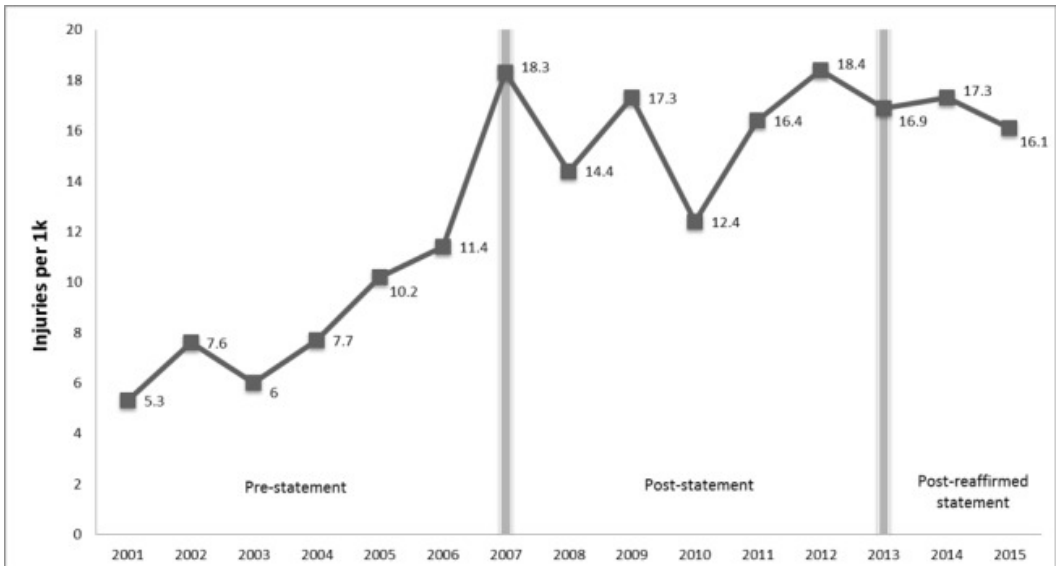


FIGURE 1. Estimated number (#) of trampoline injuries in the United States per year. AAOS and AAP statements are indicated by — and ... lines, respectively. A, Data separated by sex. B, Data separated by age groups (2 to 12 y, 13 to 18 y).

Wilson G, Sameoto C, Fitzpatrick E, Hurley KF. Impact of a Canadian Pediatric Society Position Statement on Trampoline-related Injuries at IWK Health Centre, Halifax, Nova Scotia. Cureus. 2018

In 2007, the Canadian Pediatric Society (CPS) advised against the recreational use of trampolines at home and reaffirmed that statement in 2013. A study evaluated the impact of this position statement on trampoline-related injuries at the IWK Health Centre in Halifax, Nova Scotia A retrospective analysis (2001-2015) using the IWK Health Centre's Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) database was conducted. Since the CPS statement, trampoline-related injuries significantly increased at the IWK Health Centre from 0.9% to 1.6% ($p<0.001$). Injuries increased in children under four years old and decreased in children 10-14 years ($p=0.009$). Recreational use at home (93%) remained the most common location of the incident ($p<0.001$). Fractures (n=277) and sprains/soft tissue injuries (n=232) to the ankle, head/neck, or elbow remained the most common injuries and did not significantly change post-statement or post-reaffirmed statement ($p>0.05$).[3]



WK trampoline-related ED visits, 2001-2015. Expressed as a proportion (per 1000) of all injury cases in the IWK CHIRPP database

ED: emergency department; CHIRPP: Canadian Hospitals Injury Reporting and Prevention Program

Rao DP, McFaull SR, Cheesman J, Do MT, Purcell LK, Thompson W. The ups and downs of trampolines: Injuries associated with backyard trampolines and trampoline parks. Paediatr Child Health. 2019

In researchers used the Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) records for trampoline injuries (2012 to 2016) and injuries were examined among individuals 17 years and younger. Descriptive estimates for backyard trampoline injuries (BTI) and trampoline park injuries (TPI), as well as age and sex adjusted odds ratios (OR) for the mechanism, source, body part and type of injury associated with TPIs relative to BTIs.

They found that Trampoline injuries are increasing in Canada ($P<0.01$).[4]

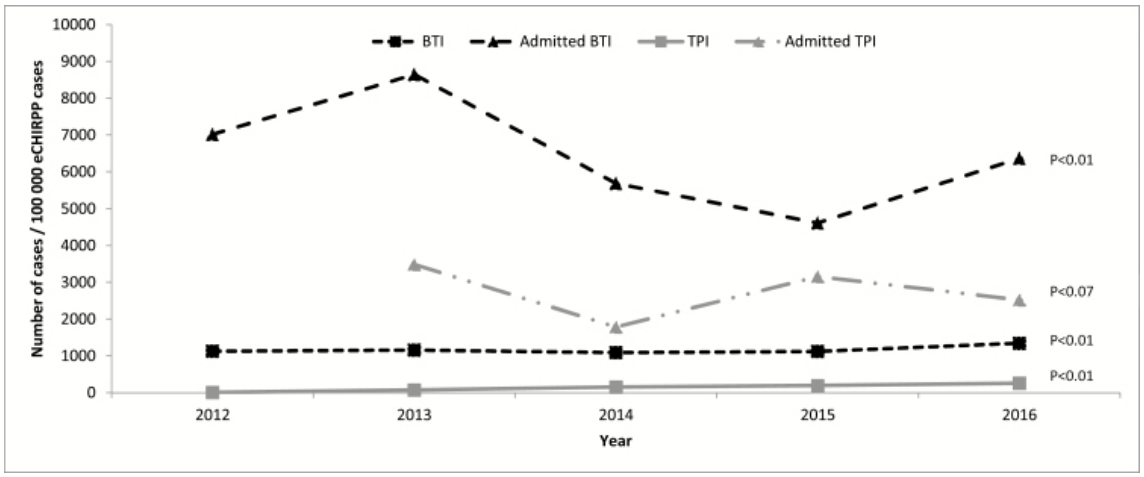
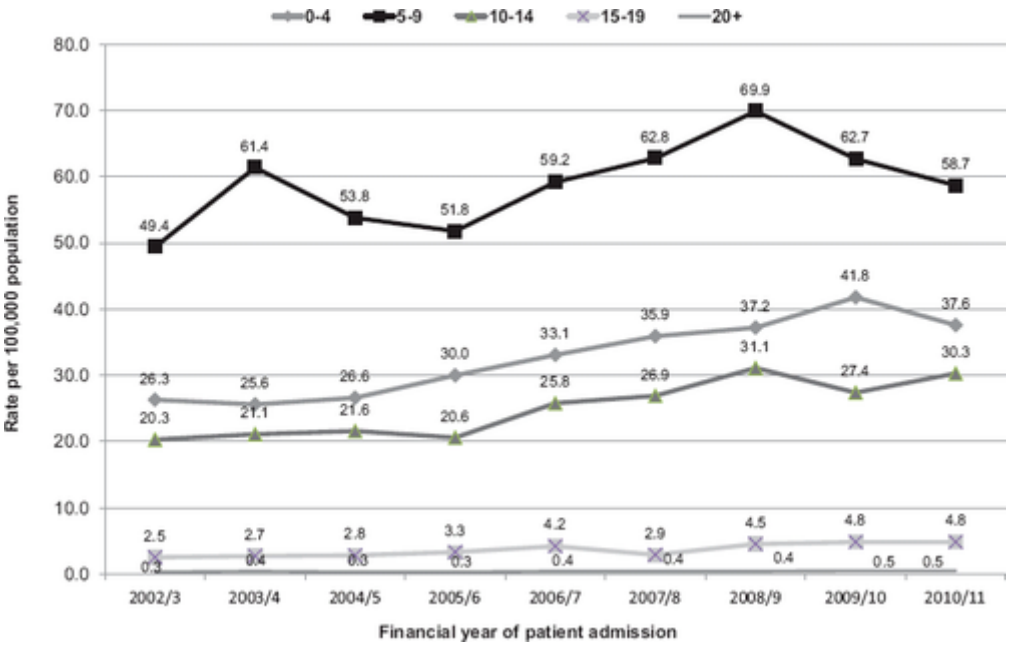


Figure. Backyard trampoline and trampoline park injury time trends, eCHIRPP, 2012–2016. Proportions of BTI and TPI cases are presented relative to other non-trampoline injuries. Proportions of admitted BTI and TPI cases are presented relative to other hospital admitted non-trampoline injuries. Records entered on or before August 24, 2016. BTI Backyard trampoline injury; TPI Trampoline park injury.

Ashby K, Pointer S, Eager D, Day L. Australian trampoline injury patterns and trends. Aust N Z J Public Health. 2015

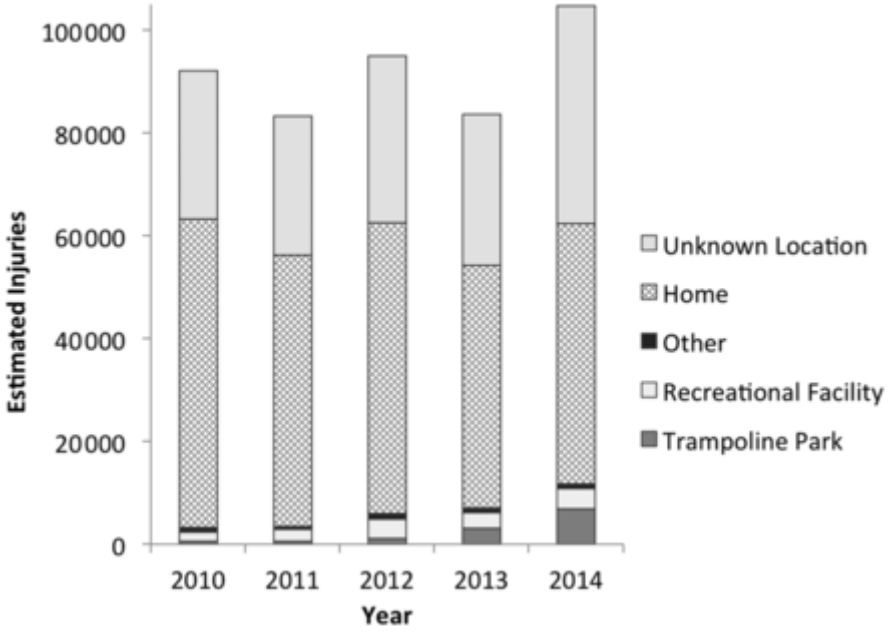
In an analysis of National Hospital Morbidity data in Australia from 2002 to 2011. There were an average 1,737 trampoline injuries reported nationally each year. Both injury frequency and rate grew. Statistically significant rate increases were observed among all age groups, although both are highest among children aged 5-9 years. Falls predominate and 81% of falls result in fracture. Non-fall injuries increased annually as a proportion of all hospitalised injury although they did not comprise more than 2.4% in any one year. The authors also stated that the major design modification--netted enclosures--could contribute to the risk of injury by leading parents to falsely believe that a netted enclosure eradicates the risk of injury.[5]



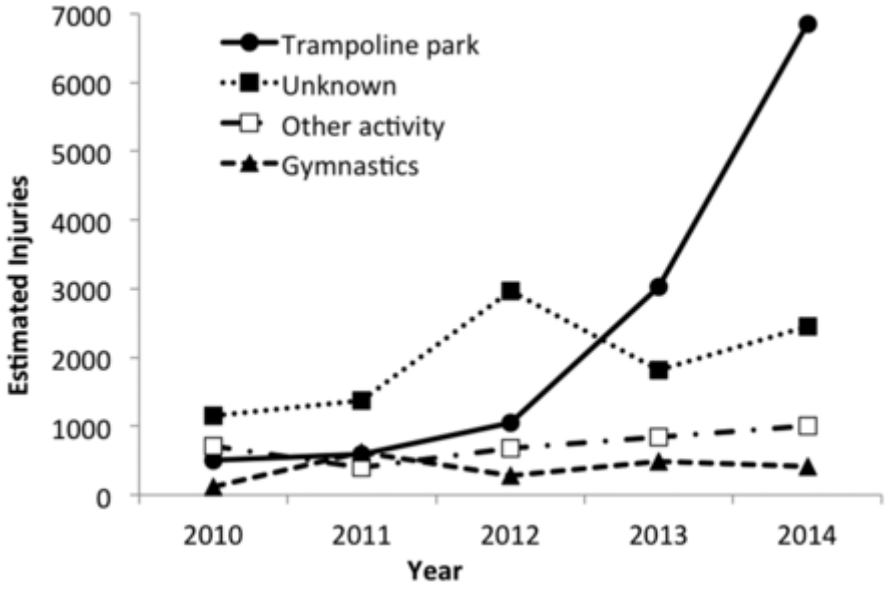
Trends in trampoline injury hospital admission rates per 100,000 population, Australia, 1 July 2002 to 30 June 2011.

Kasmire KE, Rogers SC, Sturm JJ. Trampoline Park and Home Trampoline Injuries. Pediatrics. 2016

National Electronic Injury Surveillance System from 2010 to 2014 were analysed. Sample weights were applied to estimate yearly national injury trends; unweighted cases were used for comparison of injury patterns. Estimated US emergency department visits for TPI increased significantly, from 581 in 2010 to 6932 in 2014 (P = .045), whereas HTIs did not increase (P = .13).[6]



Estimated US ED visits for trampoline injuries by location. In 2009 no TPIs were reported to the NEISS. "Other" includes schools, farms, and public properties. [6]



Trampoline injuries at recreational facilities: injuries at trampoline parks versus trampoline injuries during other recreational activities. Other activities include

trampoline injuries in cheerleading, dance, karate, playgrounds, parks, and camps. In some cases the type of activity could not be determined. [6]

Choi ES, Jang JH, Woo J-H, Choi JU, Cho JS, Yang HJ. Pediatric Trampoline-Related Injuries in a Nationwide Registry in South Korea, 2011 to 2016. Yonsei Med J. 2018

MATERIALS AND METHODS:

We conducted a nationwide retrospective cohort study. Data were collected from prospective nationwide databases (Emergency Department-based Injury In-depth Surveillance databases of the Korea Centres for Disease Control and Prevention) for patients who visited emergency departments (EDs) after injuries during 2011-2016.

Results Of 263712 patients between 0 and 17 years of age, 2799 patients with trampoline injuries visited E.Ds. Trampoline injuries and trampoline park injuries have increased steadily, while ages at injury have gradually decreased year by year ($p<0.001$). In Korea, paediatric trampoline injuries and trampoline park injuries have tended to increase, while ages at injury have tended to decrease. Policies to prevent trampoline injuries are needed.[7]

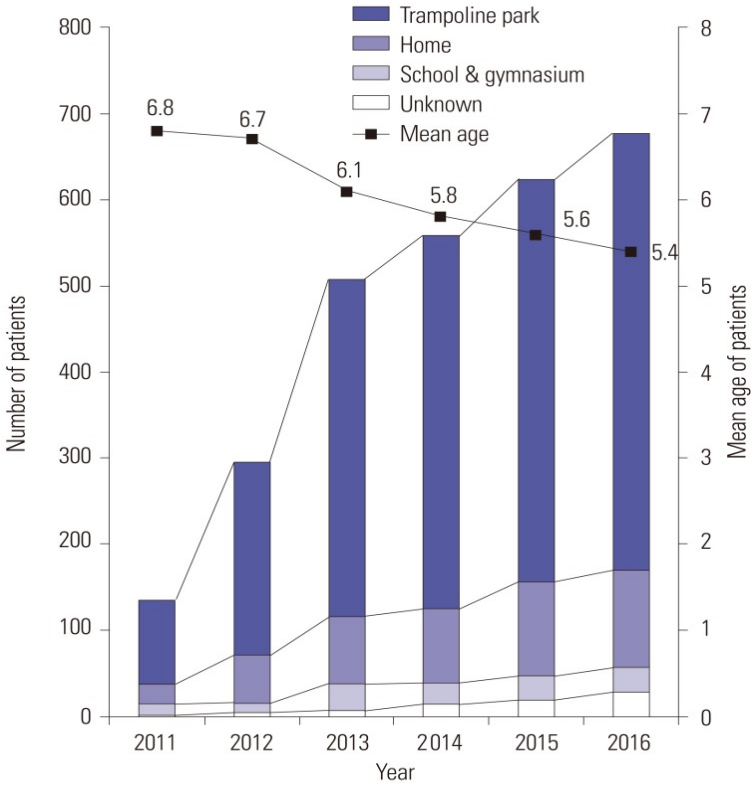


Fig. 3 Annual trends in trampoline injuries: locations of injuries and ages of patients.

Meyerber M, Fraisse B, Dhalluin T, Ryckewaert A, Violas P. Trampoline injuries compared with other child activities. *Arch Pédiatrie*. 2019

Another study in a single traumatology service in France between June and October 2016, reported that in total, 1106 children were admitted for sport related injuries including 107 trampoline accidents. Trampolining accidents were 9.7 times more common in our centre in 2016 compared with 2008.[8]

Severe Injury Mechanisms - Korhonen L, Salokorpi N, Suo-Palosaari M, Pesälä J, Serlo W, Sinikumpu J-J. Severe Trampoline Injuries: Incidence and Risk Factors in Children and Adolescents. *Eur J Pediatr Surg*. 2018

In Finland a population-based, prospective study in the Oulu region of Finland completed over 2 years (May 1, 2015 to April 31, 2017) included all children (<16 years of age) with severe trampoline injuries (cervical spine fractures, chest wall and skull fractures, lesions of internal organs, hip and knee dislocations, and permanent disorders

of the peripheral veins or nerves). The study found there were 11 injured patients (10 boys). The annual incidence was 6.28/100,000 children <16 years of age. [9]

- **EU IDB data 2013-2016 " Is there an Increase in trampoline Injuries"**

Data from the EU IDB is not suitable to answer this question as only a very low proportion of visits to Emergency departments is thought to be reported to the EU-IDB. We could observe that 62% of trampoline related injuries in EU-IDB come from the Netherlands, this leads us to believe that there is a very high underreporting from every country in Europe. In the Netherland we should now if the number of reporting hospitals have remained stable to be able to interpret the dat.

YEAR	Freq.	Percent	Cum.
2013	182	10.94	10.94
2014	479	28.79	39.72
2015	457	27.46	67.19
2016	546	32.81	100.00
Total	1,664	100.00	

However, public playground as the location had an increase in proportion of reported injuries from 2013 to 2014 after which it remained stable with a drop in 2016. This must be interpreted in light of a very high proportion of unspecified Places of Occurrence which could mean that a much higher growth may have happened has discussed in previous studies. On the other hand, Public Playgrounds may include TPIs and others since in EU-IDB no TPI code exists.

	YEAR				
PLACE_OCCUR	2013	2014	2015	2016	Total
Unspecified/others	153	357	340	449	1,299
	84.07	74.53	74.40	82.23	78.06
Public playground	7	79	81	62	229
	3.85	**16.49**	**17.72**	**11.36**	13.76
Amusement park/theme	10	9	4	14	37
	5.49	1.88	0.88	2.56	2.22
Public park	3	2	3	4	12
	1.65	0.42	0.66	0.73	0.72
Holiday park, campground	9	32	29	17	87
	4.95	6.68	6.35	3.11	5.23
Total	182	479	457	546	1,664
100.00	100.00	100.00	100.00	100.00	

---

2. What are the main injury mechanisms due to trampolines?

- **Summary of findings**

References 1,2,5,6,7,9,10; EU-IDB

Terminology in Trampoline injury literature is often used interchangeably, Mechanism of injury for example may include: stunts, another jumper, mechanisms such as fall, collision with object, collision with person, impact or even types of injury (fracture, luxation, sprain, etc).

To be comprehensive in answering this question we refer to injury mechanism (fall, collision etc., landing on trampoline edge/separator) but also type of injury (fracture, sprain, luxation/dislocation) since it is not referred in any other question. Finally, we include here information regarding conditions of occurrence or mechanism/actions that

led to the injury or risk factors (stunts, more people using trampolines, collisions with people/objects, landing on different surfaces etc.)

Most studies that report mechanisms of injury refer limitations related to data quality.

Most common mechanism are falls even though this is a low specificity code. Falls include many other mechanisms and causes of failed landings in trampoline and outside of the trampolines or on separating areas and surrounding objects.

Stunts are referred on several articles and seem to be a statistically important cause leading to spine injuries, severe injuries, and neck injuries.

Trampoline Park Injuries (TPI) and HTI (Home Trampoline Injuries) seem to have different proportions of different mechanisms of injury. In one study TPIs were more associated with impact as the mechanism, trampoline beds as the source, lower extremity as the body part and sprains as the type of injury. In contrast, another jumper or fall as the mechanism, surface or another jumper as the source, face or neck as the body part, and lacerations or soft tissue injury as the type of injury were more associated with HTIs relative to TPIs.

In another study, trampoline-related injury distribution included a higher percentage of fractures/dislocations, lower extremity fractures, fractures in adults, and surgical interventions in jump parks.

Higher number of jumpers in the same trampoline is also referred by 2 articles as a risk factor (although samples are small) and collision with a person accounts for 8.41% of all injuries in EU IDB (this number may be underreported due to poor coding practices).

It has been hypothesized that older adults jumping with children may increase the risk of injury but, despite the biomechanical rational, no statistical data was found regarding this association.

Falling on trampoline bed separators in Trampoline Parks has also been referred as a relevant mechanism of injury.

One study hypothesized that netted enclosures could contribute to the risk of injury in Home Trampolines by leading parents to falsely believe that a netted enclosure eradicates the risk of injury.

From the EU-IDB data, an injury due to a fall on the trampoline bed itself is a common form of injury (26.20%) and may be underreported as it implies coding direct object (final object of impact).

In EU-IDB coded mechanism of Injury was: Fall (77%); Collision with Person (8%); Collision with object (6%); Overexertion (5%); Unspecified (4%); Crushing (0,4%).

The Type of Injury in EU-IDB was: Fracture (45%); Distortion/sprain (18%); Unspecified (5%); Open wound (2%;) Injury to blood vessels (2%;) Luxation/dislocation (2%); Other(2%); Brain Concussion (1%).

Collision with and object, overexertion and crushing may be underreported as many may be coded as falls and should not be disregarded.

Even though it's hard to take away very consistent from heterogenous studies, in summary:

Considering Mechanism of Injury, Falls are by far the most common mechanism and they include mostly failed landings on the trampoline and falls on edge of trampoline; collision with other people and with objects are also relevant but are all much less common than falls/failed landings on trampoline; stunts are referred in one study as being an important cause of injuries accounting from 5% (lower extremities) to 25% (spine) according to body part involved. Another study reported that flips were involved in most serious injuries related to trampolines in a single Trauma Centre.

Considering the type of injury, we found that fractures are the most common injury type category (40-70%) in different studies. Contusions, Distortion/sprains are also common (around 20-40%). Luxation/dislocation, Brain Concussion are less common injuries accounting for around 1-2% of trampoline injuries.

Other relevant risk factor referred in two studies is higher number of jumpers.

- **Literature Review**

Doty J, Voskuil R, Davis C, et al. Trampoline-Related Injuries: A Comparison of Injuries Sustained at Commercial Jump Parks Versus Domestic Home Trampolines. J Am Acad Orthop Surg. 2019

INTRODUCTION:

The nature of trampoline injuries may have changed with the increasing popularity of recreational jump parks. A retrospective review was performed evaluating domestic trampoline and commercial jump park injuries over a 2-year period. patients who presented to one of the three EDs of an urban level I trauma centre after sustaining a trampoline-related injury. The study population was determined by a hospital database query of International classification of Diseases (ICD)-9 and ICD-10 injury codes for trampoline-related injuries (E005.3and Y93.44). Data collection encompassed patients of all ages during a 2-year period from January2014 to December 2015

RESULTS: There were 439 trampoline injuries: 150 (34%) at jump parks versus 289 (66%) on home trampolines. Fractures and dislocations accounted for 55% of jump park injuries versus 44% of home trampoline injuries. In adults, fractures and dislocations accounted for 45% of jump park injuries versus 17% of home trampoline injuries. More lower extremity fractures were seen at jump parks versus home trampolines in both

children and adults. Adults had a 23% surgical rate with jump park injuries versus a 10% surgical rate on home trampolines.

DISCUSSION: Trampoline-related injury distribution included a higher percentage of fractures/dislocations, lower extremity fractures, fractures in adults, and surgical interventions associated with jump parks versus home trampolines.[10]

Figure Type of Injury in Study one ED 2014-2015

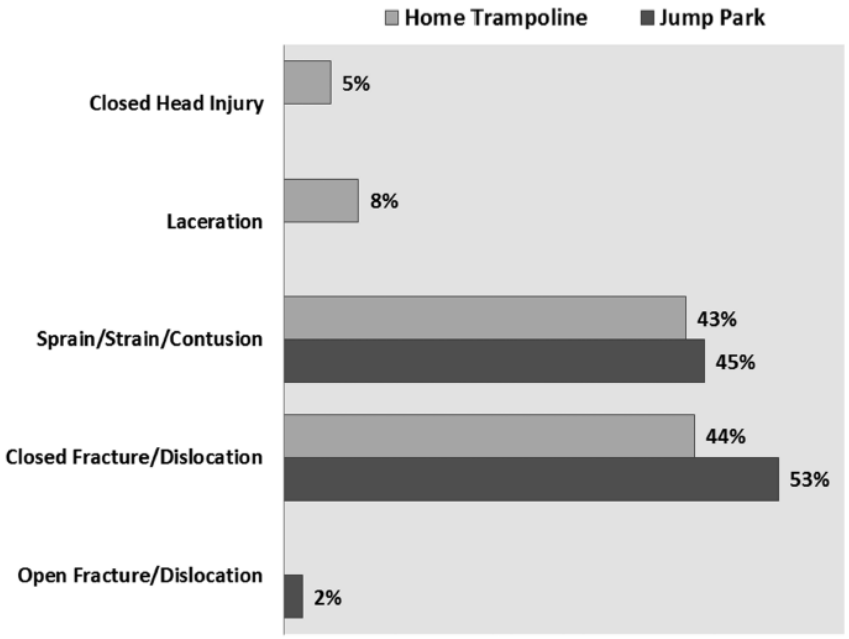


Figure Mechanism of Injury per Trampoline type in proportion 2014-2015

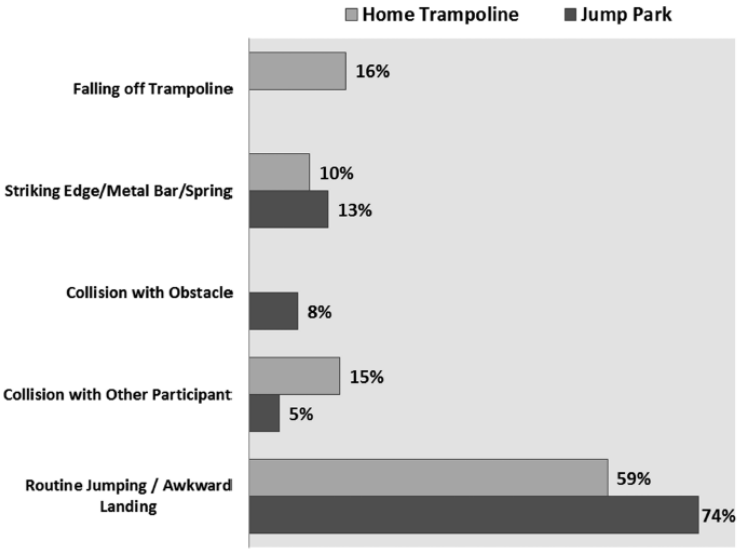


Table. Comparison between Trampoline Park and Home Trampoline Injuries

Comparison Between Trampoline-related Injuries From Jump Parks and From Home Trampolines (All Patients, Adult Patients, and Pediatric Patients)

Distribution	Jump Park	Home Trampoline	*P* Value[a]	OR[b]	95% CI
All ages (N = 439)	N = 150 (34%)	N = 289 (66%)	—	—	—
Total fractures and dislocations	83 (55%)	127 (44%)	**0.020**	1.58	1.061, 2.353
Lower extremity injuries	109 (73%)	130 (45%)	<**0.0001**	3.24	2.123, 5.007
Surgical intervention	19 (13%)	20 (7%)	0.052	1.95	0.995, 3.804
Emergency transport	18 (12%)	24 (8%)	0.220	1.50	0.778, 2.875
Hospital admission	13 (9%)	13 (4%)	0.090	2.01	0.893, 4.531
Adults (N = 69)	N = 40 (58%)	N = 29 (42%)	—	—	—
Total fractures and dislocations	18 (45%)	5 (17%)	**0.017**	3.85	1.253, 13.380
Lower extremity fractures/dislocations	17 (43%)	2 (7%)	**0.001**	9.68	2.264, 67.740
Surgical intervention	9 (23%)	3 (10%)	0.210	2.49	0.629, 12.420
Pediatrics (N = 370)	N = 110 (30%)	N = 260 (70%)	—	—	—
Total fractures and dislocations	65 (59%)	123 (47%)	**0.039**	1.61	1.024, 2.535
Lower extremity fractures/dislocations	47 (43%)	41 (16%)	<**0.0001**	3.97	2.397, 6.602
Surgical intervention	10 (9%)	17 (7%)	0.400	1.43	0.609, 3.219

Numbers in bold type denote statistically significant results, 95% CI.
CI = confidence interval, OR = odds ratio

Comparison Between Adult Patients and Pediatric Patients With Trampoline-related Injuries (All Trampolines, Jump Parks, and Home Trampolines)

Location	Pediatrics	Adults	*P* Value[a]	OR[b]	95% CI
Any trampoline (N = 439)	N = 370 (84%)	N = 69 (16%)	—	—	—
Total fractures and dislocations	188 (51%)	23 (33%)	**0.008**	2.06	1.207, 3.590
Jump park (N = 150)	N = 110 (73%)	N = 40 (27%)	—	—	—
Total fractures and dislocations	65 (59%)	18 (45%)	0.132	1.76	0.845, 3.696
Lower extremity fractures/dislocations	47 (43%)	17 (43%)	0.984	1.01	0.484, 2.127
Home trampoline (N = 289)	N = 260 (90%)	N = 29 (10%)	—	—	—
Total fractures and dislocations	123 (47%)	5 (17%)	**0.002**	4.29	1.664, 12.990
Lower extremity fractures/dislocations	41 (16%)	2 (7%)	0.207	2.52	0.667, 16.280

Numbers in bold type denote statistically significant results, 95% CI.
CI = confidence interval, OR = odds ratio
[a] Mid-*P* exact test (2-tailed)
[b] Conditional maximum likelihood estimate of OR (crude).

Comparison Between Adult Patients and Pediatric Patients With Trampoline-related Injuries (All Trampolines, Jump Parks, and Home Trampolines)

Location	Adults	Pediatrics	*P* Value[a]	OR[b]	CI
Any trampoline (N = 439)	N = 69 (16%)	N = 370 (84%)	—	—	—
Lower extremity fractures/dislocations	19 (28%)	88 (24%)	0.504	1.22	0.669, 2.158
Surgical intervention	12 (17%)	27 (7%)	**0.014**	2.67	1.239, 5.521
Jump park (N = 150)	N = 40 (27%)	N = 110 (73%)	—	—	—
Surgical intervention	9 (23%)	10 (9%)	**0.041**	2.88	1.043, 7.893
Home trampoline (N = 289)	N = 29 (10%)	N = 260 (90%)	—	—	—
Surgical intervention	3 (10%)	17 (7%)	0.451	1.65	0.364, 5.597

Numbers in bold type denote statistically significant results, 95% CI.
CI = confidence interval, OR = odds ratio
[a] Mid-*P* exact test (2-tailed)
[b] Conditional maximum likelihood estimate of odds ratio (crude)

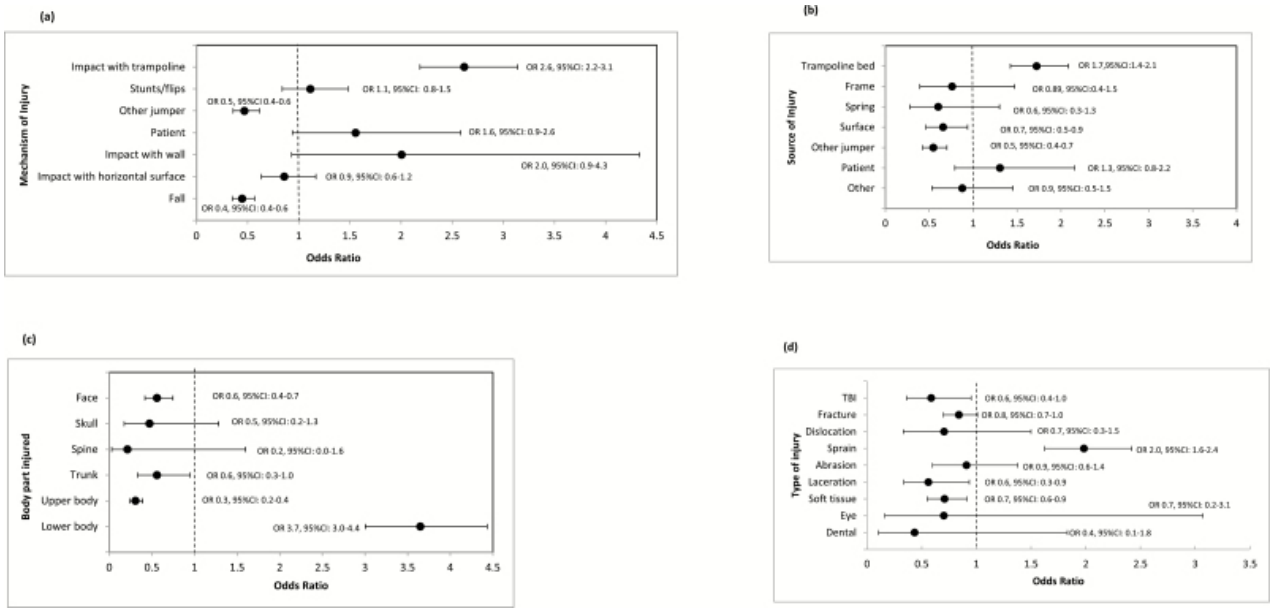
Meyerber M, Fraisse B, Dhalluin T, Ryckewaert A, Violas P. Trampoline injuries compared with other child activities. Arch Pédiatrie. 2019

Another study in a single traumatology service in France between June and October 2016, reported that in total, 1106 children were admitted for sport related injuries including 107 trampoline accidents. Several people jumping simultaneously on the trampoline was a risk factor (OR=1.56, 95% CI [1.0908, 2.308], P=0.018). Parental supervision was a protective factor (OR=0.271, 95% CI [0.08, 0.80], P=0.023).[8]

Rao DP, McFaull SR, Cheesman J, Do MT, Purcell LK, Thompson W. The ups and downs of trampolines: Injuries associated with backyard trampolines and trampoline parks. Paediatr Child Health. 2019

In researchers used the Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) records for trampoline injuries (2012 to 2016) and injuries were examined among individuals 17 years and younger. Descriptive estimates for backyard trampoline injuries (BTI) and trampoline park injuries (TPI), as well as age and sex adjusted odds ratios (OR) for the mechanism, source, body part and type of injury associated with TPIs relative to BTIs.

Patients with TPIs were older than those with BTIs. Relative to BTIs, TPIs were more associated with impact as the mechanism (OR 2.6, 95% CI: 2.2 to 3.1), trampoline beds as the source (OR 1.7, 95% CI: 1.4 to 2.1), lower extremity as the body part (OR 3.7, 95% CI: 3.0 to 4.4) and sprains as the type of injury (OR 2.0, 95% CI: 1.6 to 2.4). In contrast, another jumper (OR 0.5, 95% CI: 0.4 to 0.6) or fall (OR 0.4, 95% CI: 0.4 to 0.6) as the mechanism, surface (OR 0.7, 95% CI: 0.5 to 0.9) or another jumper (OR 0.5, 95% CI: 0.4 to 0.7) as the source, face or neck (OR 0.6, 95% CI: 0.4 to 0.7) as the body part, and lacerations (OR 0.6, 95% CI: 0.3 to 0.9) or soft tissue injury (OR 0.7, 95% CI: 0.6 to 0.9) as the type of injury were more associated with BTIs relative to TPIs.[4]



Adjusted odds ratios of injury characteristics among trampoline park injuries, relative to backyard trampoline injuries, eCHIRPP, 2012–2016. (a) Mechanism of injury. (b) Source of injury. (c) Body part injured. (d) Type of injury. Models are adjusted for age and sex. Error bars (horizontal lines) represent 95% confidence intervals. Records entered on or before August 24, 2016, Canada [4]

Table 1. Injury characteristics of backyard trampoline and trampoline park injury cases, eCHIRPP, 2012–2016, Canada [4]

	Backyard trampoline injuries		Trampoline park injuries	
	n	%	n	%
Leading mechanism of injury based on body part				
Face/Neck				
Stunts/flips	105	12.9	20	35.7
Fall	305	37.3	17	30.4
Other jumper	218	26.7	6	10.7
Other mechanism	189	23.1	13	23.2
Skull				
Other jumper	29	32.6	3	75.0
Stunts/flips	5	5.6	1	25.0
Fall	31	34.8	-	-
Other mechanism	24	27.0		
Spine				
Fall	11	35.5	1	100.0

Stunts/flips	8	25.8	-	-
Impact with horizontal surface	6	19.4	-	-
Other mechanism	6	19.4	-	-
Trunk				
Fall	99	48.1	9	56.3
Other jumper	42	20.4	1	6.3
Stunts/flips	35	17.0	4	25.0
Other mechanism	30	14.6	2	12.5
Upper extremity				
Fall	1034	53.0	47	56.6
Other jumper	403	20.7	3	3.6
Impact with horizontal surface	321	16.5	8	9.6
Other mechanism	192	9.8	25	30.1
Lower extremity				
Impact with trampoline	1409	59.5	262	65.5
Other jumper	580	24.5	51	12.8
Stunts/flips	120	5.1	29	7.3
Other mechanism	260	11.0	58	14.5
Emergency department disposition				
Left without being seen by physician	92	1.7	14	2.5
Advice only, diagnostic testing, referred to GP	1408	25.7	140	25.0
Observation in ED, follow-up PRN	69	1.3	7	1.3
Observation in ED, follow-up required	84	1.5	21	3.7
Treated in ED, with follow-up PRN	1410	25.8	167	29.8
Treated in ED, with follow-up required	2050	37.5	195	34.8
Admitted to hospital	357	6.5	17	3.0
Admitted primarily for reason other than injury treatment	3	0.1	-	
Admitted cases				
Fractures	326	90.6	11	64.7
Dislocation	10	2.8	2	11.8
Injury to internal organs	-	-	3	17.7
Soft tissue damage	7	1.9	-	-
Traumatic brain injury	5	1.4	1	5.9
Sprain	4	1.1	-	-
Abrasion	2	0.6	-	-
Laceration	1	0.3	-	-
Eye injury	1	0.3	-	-
Injury to nerve	1	0.3	-	-
Other or none detected	3	0.8	-	-

Severe Injury Mechanisms - Korhonen L, Salokorpi N, Suo-Palosaari M, Pesälä J, Serlo W, Sinikumpu J-J. Severe Trampoline Injuries: Incidence and Risk Factors in Children and Adolescents. *Eur J Pediatr Surg*. 2018

In Finland a population-based, prospective study in the Oulu region of Finland completed over 2 years (May 1, 2015 to April 31, 2017) included all children (<16 years of age) with severe trampoline injuries (cervical spine fractures, chest wall and skull fractures, lesions of internal organs, hip and knee dislocations, and permanent disorders of the peripheral veins or nerves). Multiple jumpers, stunts, younger age, previous injuries, insufficient use of safety equipment, and lack of supervision were hypothesized as risk factors. The study found there were 11 injured patients (10 boys). The annual incidence was 6.28/100,000 children <16 years of age. Mean age was 11.5 years. Severe injuries included five ligamentous cervical spine injuries and two sternal bone fractures. In addition, there were one lumbar spine ligament injury, two hip dislocations, and one severe axillary plexus nerve lesion. Eight out of 11 accidents were not seen by any adult and none of them happened under professional supervision. Most injuries (N = 8) happened by failed backflips.[9]

Ashby K, Pointer S, Eager D, Day L. Australian trampoline injury patterns and trends. Aust N Z J Public Health. 2015

In an analysis of National Hospital Morbidity data in Australia from 2002 to 2011. There were an average 1,737 trampoline injuries reported nationally each year.

Falls predominate and 81% of falls result in fracture. Non-fall injuries increased annually as a proportion of all hospitalised injury although they did not comprise more than 2.4% in any one year. The authors also stated that the major design modification--netted enclosures--could contribute to the risk of injury by leading parents to falsely believe that a netted enclosure eradicates the risk of injury.[5]

Table 1. Hospital admitted trampoline injury, by age, gender, cause, and nature of injury – Australia, 1 July 2002 to 30 June 2011.

	Falls (n=15,333)		Non-falls (n=303)		Total (n=15,636)	
	N	%	N	%	N	%
Cause						
Fall involving trampoline	15,333	100.00	-	-	15,333	98.1
Struck by/collision with person	-	-	93	30.7	93	0.6
Struck by/crush in/collision with object	-	-	62	20.5	62	0.4
Over-exertion	-	-	62	20.5	62	0.4
Other and unspecified	-	-	86	28.4	86	0.5

Wilson G, Sameoto C, Fitzpatrick E, Hurley KF. Impact of a Canadian Pediatric Society Position Statement on Trampoline-related Injuries at IWK Health Centre, Halifax, Nova Scotia. Cureus. 2018

In 2007, the Canadian Pediatric Society (CPS) advised against the recreational use of trampolines at home and reaffirmed that statement in 2013. A study evaluated the impact of this position statement on trampoline-related injuries at the IWK Health Centre in Halifax, Nova Scotia A retrospective analysis (2001-2015) using the IWK Health Centre's Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) database. Fractures (n=277) and sprains/soft tissue injuries (n=232) to the ankle, head/neck, or elbow remained the most common injuries and did not significantly change post-statement or post-reaffirmed statement ($p>0.05$).[3]

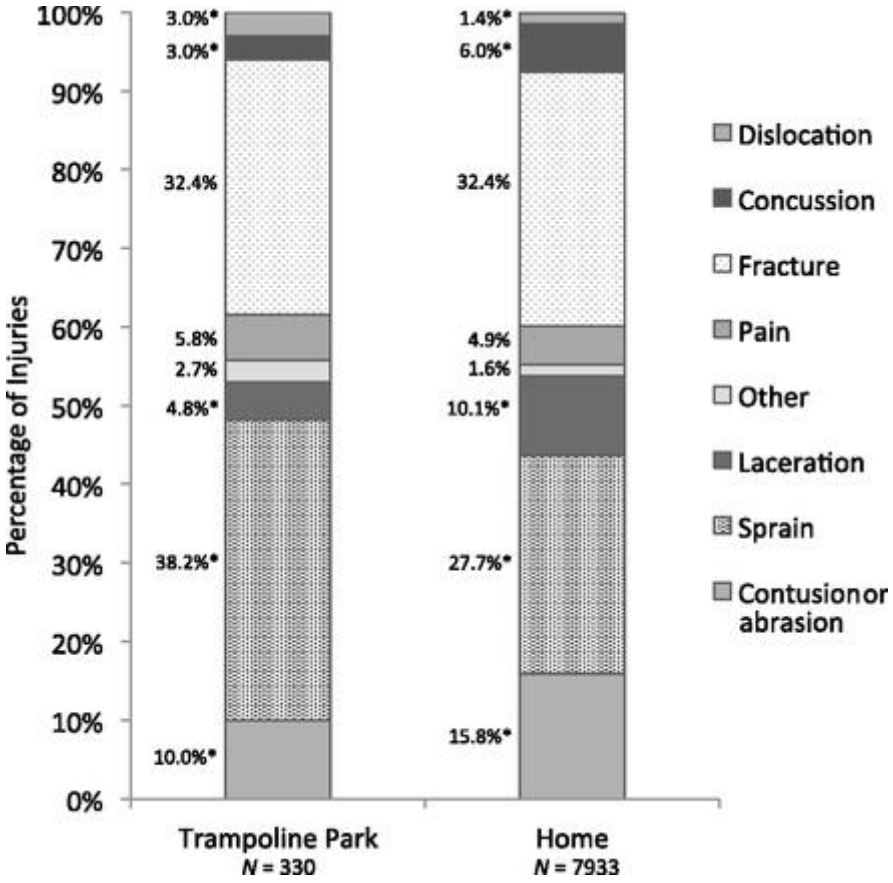
Variable	Time Frame		
	Pre-statement	Post-statement	Post-reaffirmed statement
	# cases (%)	# cases (%)	# cases (%)
Nature of injury			
Superficial	12 (3.5)	24 (5.3)	8 (5.9)
Laceration	14 (4.0)	23 (5.0)	6 (4.5)

Fracture	174 (50.3)	218 (47.9)	59 (43.7)
Sprain/soft tissue	141 (40.8)	175 (38.5)	57 (42.2)
Concussion/minor head	5 (1.4)	15 (3.3)	5 (3.7)

	Falls (n=15,333)		**Non-falls (n=303)**		**Total (n=15,636)**	
	N	**%**	**N**	**%**	**N**	**%**
Nature of main injury						
Fracture	12,424	81.0	158	52.1	12,582	80.5
Open wound	658	4.3	29	9.6	687	4.4
Dislocation, sprain/strain	500	3.3	45	14.8	545	3.5
Intracranial	379	2.5	9	3.0	388	2.5
Superficial injury	217	1.4	9	3.0	226	1.4
Other and unspecified	1,155	7.5	53	17.5	1,208	7.7

Kasmire KE, Rogers SC, Sturm JJ. Trampoline Park and Home Trampoline Injuries. Pediatrics. 2016

National Electronic Injury Surveillance System from 2010 to 2014 were analysed. Sample weights were applied to estimate yearly national injury trends; unweighted cases were used for comparison of injury patterns. Estimated US emergency department visits for TPI increased significantly, from 581 in 2010 to 6932 in 2014 (P = .045), whereas HTIs did not increase (P = .13). Patients with TPI (n = 330) were older than patients with HTI (n = 7933) (mean 13.3 vs 9.5 years, respectively, P < .001) and predominantly male. Sprains and fractures were the most common injuries at trampoline parks and homes. Compared with HTIs, TPIs were less likely to involve head injury (odds ratio [OR] 0.64; 95% confidence interval [CI], 0.46-0.89), more likely to involve lower extremity injury (OR 2.39; 95% CI, 1.91-2.98), more likely to be a dislocation (OR 2.12; 95% CI, 1.10-4.09), and more likely to warrant admission (OR 1.76; 95% CI, 1.19-2.61). TPIs necessitating hospital admission included open fractures and spinal cord injuries. TPI mechanisms included falls, contact with other jumpers, and flips.[6]



Injury types for TPIs versus HTIs. *Significant difference P < .05. [6]

Table. Injury Mechanisms at Trampoline Parks[6]

Injury Mechanism	**Injuries, (%)**	***n* Most Common Associated Injury Types**
Fell or "landed wrong"	109 (33)	Sprain (*n* = 44), fracture (*n* = 42), pain (*n* = 8)
Twisted ankle or knee	38 (12)	Sprain (*n* = 26), fracture (*n* = 9)
Injury involving another jumper	28 (8)	Fracture (*n* = 11), sprain (*n* = 6), contusion or abrasion (*n* = 4)
Flip	27 (8)	Sprain[a] (*n* = 12), fracture[b] (*n* = 9), contusion or abrasion (*n* = 2)

Injury Mechanism	Injuries, (%)	*n* Most Common Associated Injury Types
Contact with structures	22 (7)	Fracture[c] (*n* = 8), sprain (*n* = 5), laceration (*n* = 3)
Fell off trampoline	14 (4)	Fracture (*n* = 6), sprain (*n* = 4), dislocation (*n* = 1)
Knee hit face	8 (2)	Laceration (*n* = 5), facial fracture (*n* = 2)
Dodgeball	6 (2)	Sprain (*n* = 3), concussion (*n* = 1), fracture (*n* = 1)
Jumping into foam pit	4 (1)	Sprain (*n* = 3), cervical spine fracture or spinal cord injury (*n* = 1)
Other[d]	9 (3)	
Unknown	117 (35)	

a Includes 5 neck sprains.

B Includes 2 cervical spine fractures with spinal cord injury.

c Includes 3 open fractures.

- **EU IDB Data –**

What are the main injury mechanisms due to trampolines?

On this question we variables from the EU-IDB on underlying Object (Object that led to the injury), direct object (object of final contact that caused the injury), Mechanism of Injury and Type of Injury.

UNDER_OBJ	**Freq.**	**Percent**
Trampoline	1,567	95.14
Other	97	4.86
DIRECT_OBJ(impact object)	Freq.	Percent
Trampoline	436	26.20
Other	176	10,60
Not filled	1052	63.20

Mech. of Inj.	Freq.	Percent
Fall	1,274	76.56
Collision with person	140	8.41
Collision with object	92	5.53
Unspecified	62	3.73
Acute over-exertion, over-extension	46	2.76
Other specified physical over-exertion	19	1.14
Unspecified physical over-exertion	12	0.72
Others	11	0.66
Crushing	8	0.48
TYPE of Injury	Freq.	Percent
Fracture	745	44.77
Contusion	384	23.08
Distortion/sprain	298	17.91
Unspecified	85	5.11
Open wound	35	2.10
Injury to blood vessels	33	1.98
Luxation/dislocation	29	1.74
Other	26	1.56
Concussion	23	1.38
No injury	4	0.24
Other specified brain injury	2	0.12

Firstly, the trampoline-related fall code relates to any fall involving a trampoline and there is no resolution within the data as to what that actually covers (e.g. could be a fall from, fall on, or fall after a collision with another person). In fact, in the case of fall after collision, coders may deem it preferential to code to a fall as there is no 'collision on trampoline' code but there is a specific 'fall involving trampoline' code.

2 Fall
Includes:
- being pushed by a person
- falling while being carried (i.e. being dropped)
- tripping
- slipping
- falling/stumbling /jumping/pushed on the same level

- falling/stumbling /jumping/pushed from a height less than 1 meter
- falling/stumbling /jumping/pushed from a height 1 meter or more
- falling/stumbling /jumping/pushed on stairs/steps
- falling from bumping against an object
- striking or hitting an object when jumping or diving
- falling from a pedal cycle
- falling from a horse
- falling from a building or structure

Excludes:
- spraining ankle when walking and not falling (i.e. over-exertion, 8)
- being pushed by an animal (8)
- being crushed or pushed by a crowd or stampede (8)
- collapse of a non-burning building or structure (8)

3.1 Are there any age groups among children at higher risk? In terms of: Injury Frequency

- **Summary**

References 1,3,6,11; EU-IDB

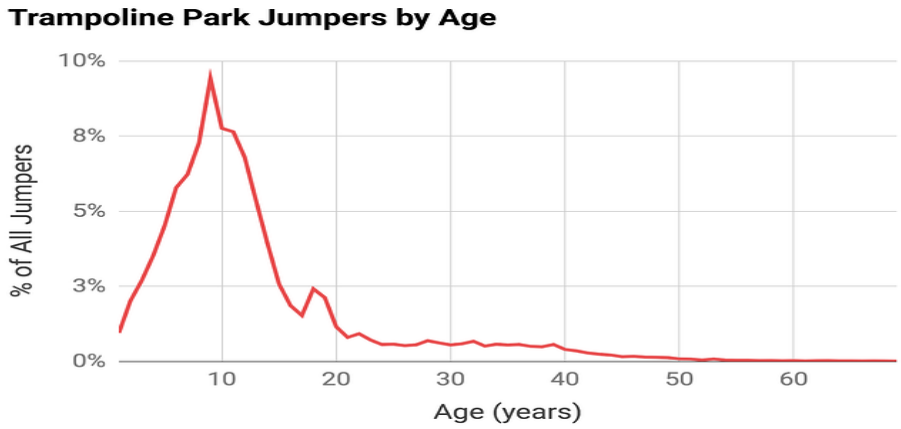
In most of the studies with large sample sizes that presented injuries per age group it was found that the age group with the most frequent injuries was 5-9 (around 40%) and this number was similar to EU IDB data.

This finding must be interpreted with caution for it may be related with higher frequency of use by children at this age group and does not necessarily mean that it is more risky per bouncing hour even though there may be reasons to hypothesize that this is the case.

Very little is publicly available on the user demographics of trampolines or trampoline parks. A recent news piece by Roller (a software company for leisure venues) reported that most frequent age of a jumper was 9, with the 6-10 age group representing 35% of all jumpers.[11] This must be taken into consideration when we look at the absolute

numbers of injuries. this age group may have more injuries just because they use it more often. That would not mean they are a higher risk group. They may however be a higher risk group for injury severity based on hospital admissions if we compare proportion of hospital admissions in different age groups as we do further with the EU IDB data, but other limitations can arise as described further.

Overall, we argue it is possible that those aged 5-9 may be at a higher risk of injury but not enough data on duration and intensity of exposure exists to confirm this hypothesis even though other biomechanical (impact of another jumper), biological (fractures risk with lower force) or behavioural factors (group pressure for stunts) can be hypothesized as relevant in this age group.



- **Literature Review**

Ashby K, Pointer S, Eager D, Day L. Australian trampoline injury patterns and trends. Aust N Z J Public Health. 2015

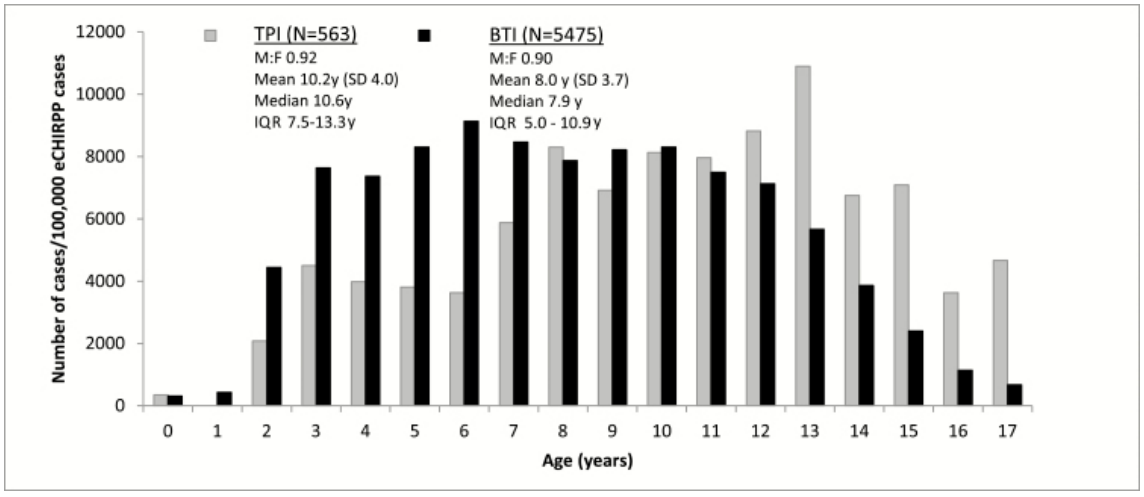
In an analysis of National Hospital Morbidity data in Australia from 2002 to 2011. There were an average 1,737 trampoline injuries reported nationally each year. Both injury frequency and rate grew. Statistically significant rate increases were observed among all age groups, although both are highest among children aged 5-9 years. [5]

	Falls (n=15,333)		Non-falls (n=303)		Total (n=15,636)	
	N	%	N	%	N	%
Age group						
0–4	4,015	26.2	49	16.2	4,064	26.0
5–9	7,142	46.6	77	25.4	7,219	46.2
10–14	3,154	20.6	96	31.7	3,250	20.8
15–19	473	3.1	42	13.9	515	3.3
20+	549	3.5	39	12.9	588	3.8

Rao DP, McFaull SR, Cheesman J, Do MT, Purcell LK, Thompson W. The ups and downs of trampolines: Injuries associated with backyard trampolines and trampoline parks. Paediatr Child Health. 2019

In researchers used the Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) records for trampoline injuries (2012 to 2016).[4]

Figure 1. Age and sex characteristics of backyard trampoline and trampoline park injury, eCHIRPP, 2012–2016. Records entered on or before August 24, 2016. BTI Backyard trampoline injury; IQR Interquartile range; 'M:F' Ratio of male to female cases; TPI Trampoline park injury.



Hadley-Miller N, Carry PM, Brazell CJ, Holmes KS, Georgopoulos G. Trends in Trampoline Fractures: 2008–2017. Pediatrics. December 2019

A study in the US with data from The National Electronic Injury Surveillance System found that between 2008 and 2017, the age group with most ED visits for trampoline related fractures was the age group of 5-9(41.9%)[1]

TABLE 1 Patient Demographics of Patients With ED Visits for Trampoline-Related Fractures (2008–2017)

	No. Actual ED Visits	Weighted National Estimate, % of All Trampoline Fractures	Lower 95% CI	Upper 95% CI
Age at injury, y				
0–4	2903	25.5	23.6	27.5
5–9	4199	41.9	40.3	43.6
10–14	2660	28.3	26.5	30.1
15–17	318	4.2	3.3	5.1

- **EUIDB data**

Injuries by age group in EU-IDB,2013-2016 (n=1664)

Age Group	Proportion	[95% Conf.	Interval]
1-4	.2409856	.221018	.26215
5-9	.4194712	.3959399	.4433744
10-14	.2986779	.2771404	.3211455
15-17	.0408654	.0323365	.0515241

Incidence is the measure of interest but it is not possible to estimate from the EUIDB 2013-2016) . However, we must keep in mind that if most users are in the age group 5-9 (as reported before) than the incidence in different age groups may be similar.

3.2 Are there any age groups among children at higher risk? In terms of: injury severity (based on hospitalization rate)

EU-IDB

- **Summary of findings**

We did not find reported differences in hospitalization rate by age group in the identified literature.

Data from the EU-IDB identified that older age group 15-17 had a higher proportion of hospitalizations (not statistically significant). These findings must be cautiously interpreted has selection bias may exist since older children may be less likely to go to an ED) Emergency Department for minor injuries.

Considering fractures as another proxy for hospitalization rate younger groups have a higher risk of fracture 52.62% of all injuries in those age 1-4 and 43.84% of injuries in those aged 5-9.

- **Literature Review**

No statistical information was found on injury severity(hospitalization rate) in different age groups.

Hadley-Miller N, Carry PM, Brazell CJ, Holmes KS, Georgopoulos G. Trends in Trampoline Fractures: 2008–2017. Pediatrics. December 2019

A study in the US with data from The National Electronic Injury Surveillance System(NEISS) found that between 2008 and 2017,there was no change in the odds of a trampoline fracture requiring hospitalization (odds ratio per 1 year: 1.02; 95% CI: 0 6-1.07; P = .5431). [1]

TABLE Patient Demographics of Patients with ED Visits for Trampoline-Related Fractures (2008–2017) NEISS

	No. Actual ED Visits	Weighted National Estimate, % of All Trampoline Fractures	Lower 95% CI	Upper 95% CI
Disposition				
Treated and/or examined and released	8557	88.3	85.8	90.8
Treated and transferred	172	3.9	2.7	5.1
Treated and admitted or hospitalized	1299	7.4	4.7	10.1
Held for observation	45	0.4	0.1	0.6
Left without being seen	7	[a]	[a]	[a]

[a] National estimates were not calculated because of small sample sizes.

- **EU IDB data**

Table . Hospital admissions by age group, RR , CI95% and pvalue, EU IDB, 2013-2016

Exposure	Total	Hospital admission(HD)	HD%	Risk Ratio	CI95%	P
1-4	401	48	11.97	-	-	Ref
5-9	698	82	11.75	0.98	[0.70-1.37]	0.913
10-14	497	57	11.47	0.96	[0.67-1.37]	0.816
15-17	68	12	17.65	1.47	[0.83-2.63]	0.195

Among all trampoline injuries in EU IDB, those aged 15-17 had a higher proportion of hospital admissions although not statistically significant. This could be due to higher number of risky stunts in this age group but could also be due to less ED visits for minor injuries in this age group as parents of younger children may make lower age groups more likely to go to an ED for a minor lesion as they usually accompany the child and may be more worried about minor injuries.

Exposure	Total	Fractures	AR%	Risk	Ratio	P
1-4	401	211	52.62	-	-	Ref
5-9	698	306	43.84	0.83	[0.74-0.94]	0.005
10-14	497	208	41.85	0.80	[0.69-0.91]	0.001
15-17	68	20	29.41	0.56	[0.38-0.82]	0.000

If we would consider Fracture as an indicator of severity, we see that fracture are more frequent in younger children (1-4) with statistically significant differences in higher age groups (almost halved in those 15-17.

Exposure	Total	Head and Neck Injury	AR%	Risk	Ratio	P
1-4	401	29	7.23	-	-	Ref
5-9	698	48	6.88	0.95	[0.61-1.48]	0.824
10-14	497	29	5.84	0.81	[0.49-1.33]	0.397
15-17	68	9	13.24	1.83	[0.91-3.69]	0.093

3.3 Are there any age groups among children at higher risk? In terms of: injury mechanism

Ref EU-IDB

- **Summary of Findings**

No retrieved literature was found comparing mechanism of injury by age group.

In EU-IDB mechanisms of injury are similar in different age groups (non statistically significant differences). Nevertheless, it is possible to identify the following minor differences. Overexertion “overexertion of one’s body or a body part, causing damage

to muscle, tendon, ligament, cartilage, joint, or peripheral nerve (e.g., common cause of strains, sprains, and twisted ankles is less common in younger age groups)" is more common among those aged 15-17 (borderline not statistically significant) and Luxations/dislocations are more common in that same age group , 5.9%. Collision with object and collision with person is slightly more frequent as a cause of injury among those aged 5-9.

Types of injuries are similar among age groups except fractures which are more common in younger age groups as previously referred (statistically significant).

- **Literature Review**

We found no literature comparing mechanism of injury in different age groups.

- **EU IDB data**

	1-4	**5-9**	**10-14**	**15-17**
	n=401	n=698	n=497	n=68
Mechanism of injury				
Other/unspecified	20 (5.0%)	36 (5.2%)	24 (4.8%)	1 (1.5%)
Overexertion	16 (4.0%)	24 (3.4%)	31 (6.2%)	6 (8.8%)
Collision with object	15 (3.7%)	44 (6.3%)	29 (5.8%)	4 (5.9%)
Collision with Person	34 (8.5%)	66 (9.5%)	34 (6.8%)	6 (8.8%)
Fall	316 (78.8%)	528 (75.6%)	379 (76.3%)	51 (75.0%)

p=0.21

Overall Mechanism of Injury look similar in different age groups.

Overexertion	Total	Cases	AR%	Risk	Ratio	P
1-4	401	16	3.99	-	-	Ref
5-9	698	24	3.44	0.86	[0.46-1.60]	0.638
10-14	497	31	6.24	1.56	[0.87-2.82]	0.133
15-17	68	6	8.82	2.21	[0.90-5.45]	0.081

Overexertion as the mechanism of injury is more common among those aged 15-17 and borderline not significant.

Collision with object	Total	Cases	AR%	Risk	Ratio	P
1-4	401	15	3.74	-	-	Ref
5-9	698	44	6.30	1.69	[0.95-2.99]	0.070
10-14	497	29	5.84	1.56	[0.85-2.87]	0.148
15-17	68	4	5.88	1.57	[0.54-4.60]	0.407

Those aged 5-9 appear to have a higher risk of lesions from collision with objects but I borderline statistically insignificant assuming 1-4 as reference category.

Collision with Person	Total	Cases	AR%	Risk	Ratio	P
1-4	401	34	8.48			
5-9	698	66	9.46	1.12	[0.75-1.66]	0.588
10-14	497	34	6.84	0.81	[0.51-1.27]	0.356
15-17	68	6	8.82	1.04	[0.45-2.38]	0.925

Collision with other person is not statistically associated with any specific age group.

Fall	Total	Cases	AR%	Risk	Ratio	P
1-4	401	316	78.80			
5-9	698	528	75.64	0.96	[0.90-1.03]	0.232
10-14	497	379	76.26	0.97	[0.90-1.04]	0.365
15-17	68	51	75.00	0.95	[0.82-1.10]	0.482

Fall, the most common registered mechanism of injury does not show relevant differences between age groups. This could be related to low specificity of Fall coding in trampoline activity.

In terms of Type of Injury ,

	Age Group=0	**Age Group=1**	**Age Group=2**	**Age Group=3**
	n=401	n=698	n=497	n=68
				p<0.001
Minor injury (contusion , abrasion, open wound)	105 (26.2%)	163 (23.4%)	130 (26.3%)	21 (30.9%)
Fracture	211 (52.6%)	306 (43.9%)	208 (42.1%)	20 (29.4%)
Luxation/dislocation	6 (1.5%)	5 (0.7%)	14 (2.8%)	4 (5.9%)
Distortion/sprain	45 (11.2%)	146 (20.9%)	95 (19.2%)	12 (17.6%)
Concussion	9 (2.2%)	11 (1.6%)	4 (0.8%)	1 (1.5%)
Other	25 (6.2%)	66 (9.5%)	43 (8.7%)	10 (14.7%)

Luxations/dislocations are more common in older age groups , 5.9% in those aged 15-17 . Fractures are more common in younger age groups as previously referred.

4. What are the major injury locations (part of the body) due to trampolines?

Ref 1,3,7,10,12 ; EU-IDB

- **Summary of Findings**

Some studies report all injuries and some studies focus on fractures.

Proportion of injuries/fracture in different studies vary but lower limbs and upper limbs are systematically in all retrieved studies the most common body parts injured usually making up more than 60% of all injuries.

Head Injury makes up to around 5-18% of all injuries and neck injuries are around 2%-5% in retrieved studies and in the EU-IDB.

In the EU-IDB Head and Neck injuries (aggregated) are more almost twice as common in males (statistically significant) and the association remains after adjusting for possible confounders (annex 1). This raises the hypothesis that males try more often risky stunts that involve having their feet above their head.

- **Literature Review**

Hadley-Miller N, Carry PM, Brazell CJ, Holmes KS, Georgopoulos G. Trends in Trampoline Fractures: 2008–2017. Pediatrics. December 2019

A study in the US with data from The National Electronic Injury Surveillance System between 2008 and 2017, analysed Fractures by anatomic region.[1]

TABLE 2 Summary of NEISS Paediatric Trampoline Fractures by Anatomic Region

Fracture Location	No. Actual ED Visits	Weighted National Estimate, % of All Trampoline Fractures	Lower 95% CI	Upper 95% CI
Shoulder, including clavicle	303	3.3	2.8	3.7
Upper trunk	52	[a]	[a]	[a]
Elbow	1480	12.4	11.0	13.8
Radius and/or ulna	2346	21.5	19.8	23.2
Wrist	633	9.0	7.6	10.5
Knee	112	1.2	0.9	1.5
Tibia and/or fibula	2124	18.3	16.7	19.9
Ankle	784	9.8	8.4	11.1
Head	38	[a]	[a]	[a]
Face	190	2.1	1.7	2.5
Lower trunk	39	0.6	0.3	0.8
Ulna	683	7.3	6.0	8.6
Femur	247	2.3	1.6	2.9
Hand	111	1.2	0.9	1.6
Foot	297	3.6	2.8	4.4
Neck	15	0.1	0.0	0.1
Finger	462	4.8	4.2	5.5
Toe	164	1.8	1.4	2.2

[a] National estimates were not calculated because of small sample sizes.

Kirkwood G, Hughes TC, Pollock AM. Results on sports-related injuries in children from NHS emergency care dataset Oxfordshire pilot: an ecological study. J R Soc Med. 2019[11]

Summary: Objectives: To analyse and report on sports-related injuries using enhanced injury data collected by the testbed for the NHS emergency care injury data set and admissions data collected from inpatients. Design: Ecological study design. Setting: Two Oxfordshire NHS England hospitals. Participants: Emergency department attendees and inpatients aged 0–19 years with sports injuries. Main outcome measures: Data were analysed from 1January 2012 to 30 March 2014 by age, gender sport, injury location, injury mechanism and diagnosis including concussion/post-concussion, bone fractures and ligament damage. Admissions data were analysed from 1 January2012 to 24 January 2015.

Table Emergency department attendances from sports-related injury in those aged 0–19 years, January 2012 to March 2014 Oxfordshire England. Top five sports and all sports by gender and main diagnosis body site with percentages of all injuries, including fractures, concussion/post-concussion and ligament damage diagnosis.

Gender	Sport	Diagnosis body site									Fractures (percentage of all sport fractures)	Ligament damage	Concussion/ post-concussion
		Head	Neck	Upper limb	Abdomen, spine, thorax, pelvis	Lower limb	Injuries, site unspecified	Other diagnosis	No diagnosis	Total			
Males	Trampoline	23 (14.5 %)	4 (2.5 %)	38 (23.9 %)	1 (0.6%)	26 (16.4 %)	36 (22.6%)	18 (11.3%)	13 (8.2%)	159 (100 %)	42 (4.8%)	1	0
Females	Trampoline	11 (5.2 %)	4 (1.9 %)	37 (17.4 %)	1 (0.5%)	44 (20.7 %)	70 (32.9%)	24 (11.3%)	22 (10.3%)	213 (100 %)	55 (14.5%)	3	1

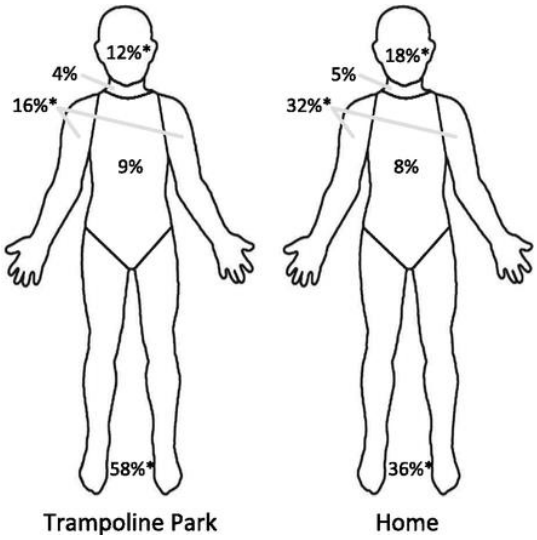
Ashby K, Pointer S, Eager D, Day L. Australian trampoline injury patterns and trends. Aust N Z J Public Health. 2015

In an analysis of National Hospital Morbidity data in Australia from 2002 to 2011. There were an average 1,737 trampoline injuries reported nationally each year..[5]

	Falls (n=15,333)		Non-falls (n=303)		Total (n=15,636)	
	N	%	N	%	N	%
Body region injured						
Head/face	1,676	10.9	76	25.1	1,752	11.2
Trunk incl. neck	867	5.6	49	16.2	916	5.9
Upper limb	10,757	70.1	57	18.8	10,814	69.2
Lower limb	2,003	13.1	119	39.3	2,122	13.6
Other and unspecified	30	0.2	2	0.6	32	0.2

Kasmire KE, Rogers SC, Sturm JJ. Trampoline Park and Home Trampoline Injuries. Pediatrics. 2016

National Electronic Injury Surveillance System from 2010 to 2014 were analysed. Sample weights were applied to estimate yearly national injury trends



Distribution of injuries: body part injured (by percentage) at trampoline parks (n = 330) and home trampolines (n = 7933). *Significant difference P < .05. [6]

Doty J, Voskuil R, Davis C, et al. Trampoline-Related Injuries: A Comparison of Injuries Sustained at Commercial Jump Parks Versus Domestic Home Trampolines. J Am Acad Orthop Surg. 2019

A retrospective review was performed evaluating domestic trampoline and commercial jump park injuries over a 2-year period. patients who presented to one of the three EDs of an urban level I trauma centre after sustaining a trampoline-related injury.

Trampoline-related injury distribution included a higher percentage of, lower extremity fractures and surgical interventions associated with jump parks versus home trampolines.[10]

Figure . Number of Injuries per body part in Home Trampoline and Jump Parks ,2014-2015

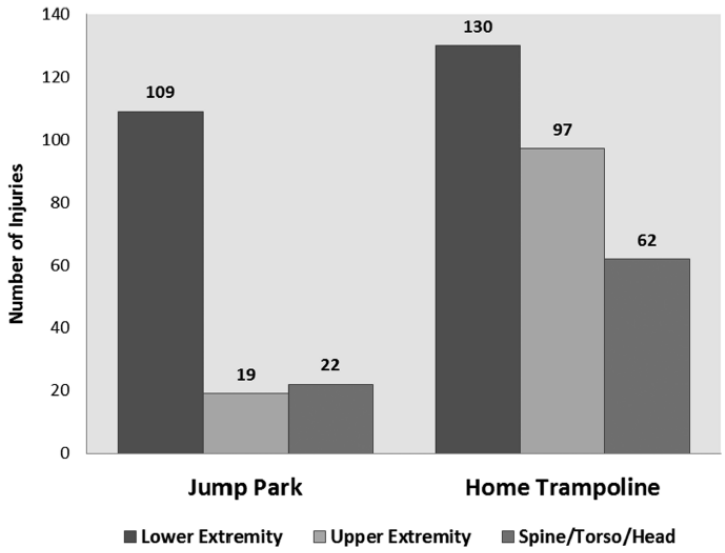
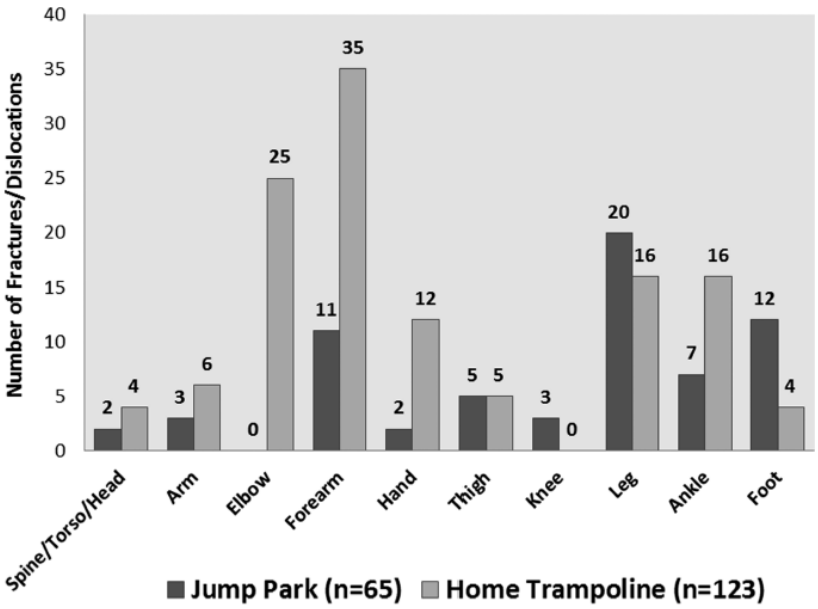


Figure .Number of Fractures/Dislocations per body part



- **EU IDB data**

Proportion of injuries per Body Part, EU-IDB, 2013-2016

BODY_1	Freq.	Percent
Ankle	357	21.45
Lower leg	162	9.74
Foot	156	9.38
Elbow	149	8.95
Forearm	119	7.15
Wrist	116	6.97
Knee	88	5.29
Hand, fingers	86	5.17
Body part unspecified	83	4.99
Upper arm	82	4.93
Shoulder	35	2.10
Face	28	1.68
Brain	25	1.50
Abdomen, lower back, lumbar spine	25	1.50
Neck unspecified	24	1.44
Skull	20	1.20
Upper leg	18	1.08
Thorax	16	0.96
Neck, other	12	0.72
Cervical Spine	10	0.60
Thoracic Spine	9	0.54
Head, other	9	0.54
Lower extremities unspecified	9	0.54
Body part, other	8	0.48
Head unspecified	6	0.36
Others	12	0.72

Proportion of injuries per Body Part, EU-IDB, 2013-2016

BODY_1	Freq.	Percent	Cum.
Head	88	5.29	5.29
Neck	46	2.76	8.05
Trunk	56	3.37	11.42
Upper limbs	590	35.46	46.88
Lower Limbs	791	47.54	94.41
Others	93	5.59	100.00
Total	1,664	100.00	

Bivariable analysis sex and Head and Neck Injuries

Exposure	Total	Head/Neck	AR%	Total	Cases	AR%	Risk	Ratio	P
Male	810	75	9.26	854	40	4.68	1.98	[1.36-2.87]	0.000

5. Simultaneous trampoline users

Ref 13, 14 ,15 ;EU-IDB

- **Summary**

Epidemiological evidence on simultaneous trampoline users during injury or the risk associated with this practice is scarce and studies that found associations (2) usually have small samples. This is because apparently Injury surveillance systems do not allow for registry the number of users and this was done in single centres over a short period of time for specific research projects.

However, there is some evidence that this practice may increase the risk, especially when users are of different weights as hypothesized bellow in an article using biomechanical simulation computer models.

- **Literature Review**

Roffe L, Pearson S, Sharr J, Ardagh M. The effect of trampoline parks on presentations to the Christchurch Emergency Department. N Z Med J. 2018

A study from 2018 aimed to analyse trampoline-related injuries suffered after the opening of two new trampoline parks in Christchurch. All trampoline-related injuries were collected from electronic documentation and coding. In the 90 days after both parks opened there were 602 claims for trampoline-related injuries with 106 hospital presentations. One trampoline park allowed two or more people to use the same trampoline at the same time, and had over twice as many presentations (33%, n=35) than the other trampoline park (14%, n=15) [12]

Note: The sample of study in the previous article is small.

Mulligan CS, Adams S, Brown J. Paediatric injury from indoor trampoline centres. Inj Prev. 2017

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.[13]

Note: The sample of study in the previous article is small.

In this review we focus on epidemiological evidence although other studies have analyse biomechanical mechanisms pf injury possibly associated with multiple trampoline users

Menelaws S, Bogacz AR, Drew T, Paterson BC. Trampoline-related injuries in children: A preliminary biomechanical model of multiple users. *Emerg Med J*. 2011

This study sought to examine and simulate the forces and energy transferred to a child's limbs when trampolining with another person of greater mass.

Methods The study used a computational biomechanical model.

Results The simulation demonstrated that when two masses bounce out of phase on a trampoline, a transfer of kinetic energy from the larger mass to the smaller mass is likely to occur. It predicted that when an 80 kg adult is on a trampoline with a 25 kg child, the energy transfer is equivalent to the child falling 2.8 m onto a solid surface. Additionally, the rate of loading on the child's bones and ligaments is greater than that on the accompanying adult.

Conclusions Current guidelines are clear that more than one user on a trampoline at a time is a risk factor for serious injury; however, most injuries happen in this scenario. The model predicted that there are high energy transfers resulting in serious fracture and ligamentous injuries to children and that this could be equated to equivalent fall heights. This provides a clear take-home message, which can be conveyed to parents to reduce the incidence of trampoline-related[14]

- **EU IDB data**

Number of people using a Trampoline is not available in the EU-IDB. However, we checked if collision with person had a higher rate of hospital admissions among those whose mechanism of injury were collision with person. Among those who had collision with a person, the hospital admission rate is lower, 7.86% than those "unspecified" and "falls" , but not statistically significant.

	Exposure	Total	Admitted to Hospital	AR%	RR	CI95	P
Mechanism of Injury	Other/unspecified	81	9	11.11	-	-	Ref
	Overexertion	77	1	1.30	0.12	[0.02-0.90]	0.011
	Collision with object	92	1	1.09	0.10	[0.01-0.76]	0.005
	Collision with Person	140	11	7.86	0.71	[0.31-1.63]	0.417
	Fall	1274	177	13.89	1.25	[0.67-2.35]	0.480

6.Trampoline size (small vs. larger trampolines)

- **Summary of Findings**

We found no robust scientific literature regarding trampoline size impact on injury or injury severity even though the biomechanical rational is expected that with higher jumps (higher bouncing power, not necessarily related to larger trampolines), any impact of a failed landing or collision/crushing will be higher and result in more severe injury. Larger Trampolines may be more inviting to multiple users leading to the possible

consequences of multiple users in increase in rebound, failed landings and high impact with the trampoline or collisions.

No data related to trampoline size exists in EU IDB.

- **Literature Review**

We found no scientific literature regarding trampoline size impact on injury or injury severity even though the biomechanical rational to expect that with higher jumps, any impact of a failed landing or collision/crushing will be higher and result in more severe injury.

- **EU IDB data**

(no data related to trampoline size)

II. Purpose: Trampoline injuries in trampoline parks

7. Do we observe an increase in trampoline injuries due to trampoline parks?

Ref 2,3,4,5,6,7 ; EU-IDB

- **Summary of Findings**

Injuries in Trampoline Parks are rising.

One study in the USA using National Electronic Injury Surveillance based study found an increase in TPI from 581 in 2010 to 6,932 in 2014 (2010/2014).

Different studies have found that injuries in Trampoline parks are rising while injuries in trampolines elsewhere have remained stable or with lower increase rate. The rise in Trampoline Injuries in some studies is mostly attributable to Trampoline Parks.

In studies in specific regions or Trauma Centres the opening of Trampoline Parks in the area led to important increases in Trampoline Injuries in that area, attributable to the Trampoline Parks with significant burden on ED and Trauma Centres.

In the EU-IDB injuries in Public Playgrounds and similar (aggregated Public Playgrounds, Holiday parks, Amusement Parks and Public Parks) have become more frequent in more recent years. In 2013 it was 3.85% and in the following years it was 16.49% (2014), 17.72% (2015) and 11.36% (2016).

- **Literature Review**

Literature review related to this question should be checked in Question 1.

Hadley-Miller N, Carry PM, Brazell CJ, Holmes KS, Georgopoulos G. Trends in Trampoline Fractures: 2008–2017. Paediatrics. December 2019

A study in the US with data from The National Electronic Injury Surveillance System found that between 2008 and 2017, there was a 3.85% (95% confidence interval [CI]: 0.51-7.30) increase in the incidence of trampoline-related paediatric fractures per person-year. There was no change in the odds of a trampoline fracture requiring hospitalization (odds ratio per 1 year: 1.02; 95% CI: 0 6-1.07; P = .5431). There was a significant increase in the odds of a fracture occurring at a place of recreation or sport (odds ratio per year: 1.32; 95% CI: 1.21-1.43; P < .0001).[1]

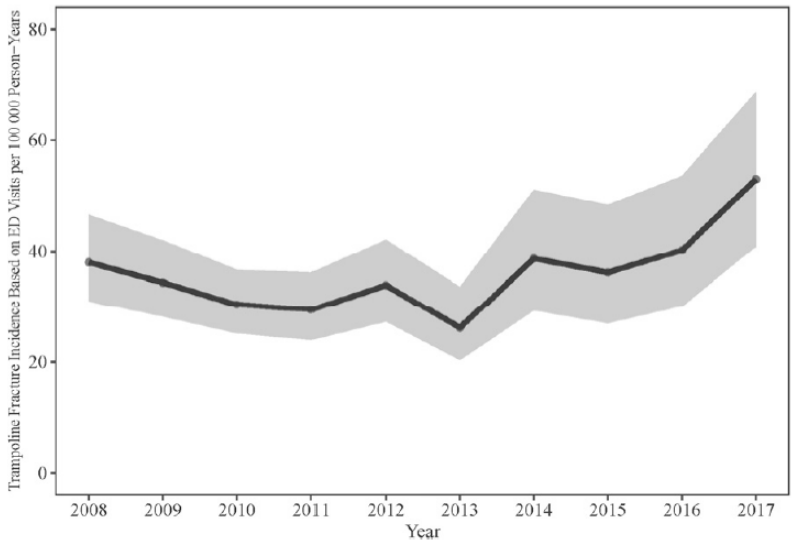


Figure . Incidence of trampoline fractures: 2008–2017. Incidence of paediatric trampoline fractures presenting to EDs in the United States between 2008 and 2017 is shown. Numerator data were obtained from NEISS by using nationally representative frequency estimates. Denominator data were obtained from US census estimates among individuals in the United States ,18 years of age.

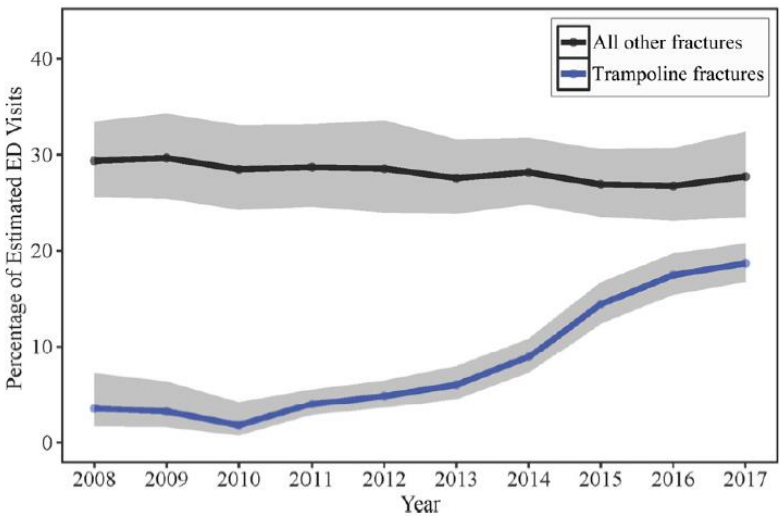


Figure Percentage of fractures that occurred at a sports-related location: trampoline-related fractures versus all other fractures. Highlighted is the differential shift in the

proportion of paediatric fractures coded as occurring at a sports-related location among trampoline fractures compared with all other fractures. Represented by the interaction analysis, the yearly increase in the proportion of fractures coded as occurring at a sports-related location was significantly higher among trampoline fractures compared with all other fractures.

- **EU-IDB 2013-2016**

Public playground as the location in EU-IDB had an increase in proportion of reported injuries from 2013 to 2014 after which it remained stable with a drop in 2016. This must be interpreted considering a very high proportion of unspecified Places of Occurrence which could mean that a much higher growth may have happened has discussed in previous studies.

	YEAR				
PLACE_OCCUR	2013	2014	2015	2016	Total
Unspecified/others	153	357	340	449	1,299
	84.07	74.53	74.40	82.23	78.06
Public playground	7	79	81	62	229
	3.85	**16.49**	**17.72**	**11.36**	13.76
Amusement park/theme	10	9	4	14	37
	5.49	1.88	0.88	2.56	2.22
Public park	3	2	3	4	12
	1.65	0.42	0.66	0.73	0.72
Holiday park, campground	9	32	29	17	87
	4.95	6.68	6.35	3.11	5.23
Total	182	479	457	546	1,664
100.00	100.00	100.00	100.00	100.00	

8. What are the main injury mechanisms due to trampolines in trampoline parks?

Ref 5,6,10; EU-IDB

- **Summary of Findings**

Injury Mechanisms in Trampolines park seem to differ from those in Home Trampolines in different studies, but results differ.

In a large national study in Canada, TPIs were more associated with impact (overall) as the mechanism, trampoline beds as the source, lower extremity as the body part and sprains as the type of injury. In contrast, another jumper or fall as the mechanism, surface or another jumper as the source, face or neck as the body part, and lacerations or soft tissue injury as the type of injury were more associated with BTIs relative to TPIs.

In other relevant study, trampoline-related injury distribution included a higher percentage of fractures/dislocations, lower extremity fractures, fractures in adults, and surgical interventions associated with jump parks versus home trampolines.

In another single centre study from 2014-2015 Trampoline-related injury distribution included a higher percentage of lower extremity fractures and surgical interventions associated with jump parks versus home trampolines.

In other study using NEISS 2010 to 2014 those in Trampoline Parks suffered more frequently sprains and fractures (lower sprains and fractures (lower extremity), required more hospital admissions and suffered more severe injuries like open fractures and spinal cord injuries.

In EU-IDB no code exists for Trampoline Parks as Place of occurrence. This is an important limitation when using this data to analyse TPIs. In Place of occurrence in EU IDB 78% are unspecified followed by Public Playgrounds (14%) Holiday park,

campgrounds (5%) and Amusement Parks/Theme Parks (2%). We believe a significant part of those must be Trampoline Parks but limitations in interpretation are relevant.

In the EU-IDB, Mechanisms of Injury seem to be similar for Public Playgrounds and similar (aggregated Public Playgrounds, Holiday parks, Amusement Parks and Public Parks) and other Places of Occurrence. Only "collision with objects" seem to be less common, eventually because trampoline parks or trampolines in public areas are designed/positioned in a way that collision with objects is unlikely. However, when it comes to type of injury, "fractures" and "distortions/sprains" are more common in Public Playground and similar (statistically significant).

- **Literature Review**

Literature Review should be consulted in Question 2. As it includes all retrieved studies with mechanisms of Injury including injuries in Trampoline Parks (when reported)

- **EU-IDB**

Mechanism of Injury by Place of Occurrence

	All others	**Public Park**
	n=1299	n=365
Mech. of Inj.		
Other/unspecified	72 (5.5%)	9 (2.5%)
Overexertion	64 (4.9%)	13 (3.6%)
Collision with object	80 (6.2%)	12 (3.3%)
Collision with Person	109 (8.4%)	31 (8.5%)
Fall	974 (75.0%)	300 (82.2%)

P= 0.012

Type of Injury by Place of Occurrence

	All others	Public Park
TYPE_1	n=1299	n=365
Minor injury (contusion , abrasion, open wound)	349 (26.9%)	70 (19.3%)
Fracture	560 (43.2%)	185 (51.0%)
Luxation/dislocation	22 (1.7%)	7 (1.9%)
Distortion/sprain	225 (17.3%)	73 (20.1%)
Concussion	25 (1.9%)	0 (0.0%)
Other	116 (8.9%)	28 (7.7%)

P=0.002

9.1 Are there any age groups among children at higher risk in trampoline parks?

In terms of: injury pattern

Reference EU-IDB

- **Summary of Findings**

No literature was found regarding this specific question.

From the EU-IDB data, no statistically significant differences were found in types of injury in different age groups among Injuries in "Public Playgrounds and similar" as statistical power was lost due to a sample of only 365 observations. Fractures were more common in the younger age group 1-4 (59%) compared to other groups(45%-48%) and the difference was borderline non statistically significant.

In terms of Mechanism of Injury as coded in EU-IDB , those aged 5-9 have a higher proportion of "collision with person"(non statistically significant). Overexertion is more common in those aged 10-14(statistically significant).

Injuries in the head or neck(aggregated, all) have no statistically significant difference in different age groups.

- **Literature Review**

No literature was found regarding this specific question.

- **EU-IDB**

Type of Injury by age group in Public Playgrounds and similar

	Age Group=0	**Age Group=1**	**Age Group=2**	**Age Group=3**
	n=103	n=162	n=89	n=11
Type of injury				
>	p =0.54			
Minor injury (contusion , abrasion, open wound)	19 (18.4%)	33 (20.4%)	17 (19.5%)	1 (9.1%)
Fracture	61 (59.2%)	78 (48.1%)	41 (47.1%)	5 (45.5%)
Luxation/dislocation	2 (1.9%)	3 (1.9%)	1 (1.1%)	1 (9.1%)
Distortion/sprain	16 (15.5%)	36 (22.2%)	19 (21.8%)	2 (18.2%)
Concussion	5 (4.9%)	12 (7.4%)	9 (10.3%)	2 (18.2%)

Proportion of Fractures by age group in Public Playgrounds and similar

Exposure	**Total**	**Fractures**	**AR%**	**RR**	**CI95**	**P**
1-4	103	61	59.22			
5-9	162	78	48.15	0.81	[0.65-1.02]	0.078
10-14	89	41	46.07	0.78	[0.59-1.03]	0.069
15-17	11	5	45.45	0.77	[0.39-1.50]	0.379

Mechanism of Injury by age group in Public Playgrounds and similar

		Age Group=0	Age Group=1	Age Group=2	Age Group=3
		n=103	n=162	n=89	n=11
Mech. of Inj.					
>	p	=0.025			
Other/unspecified		5 (4.9%)	3 (1.9%)	1 (1.1%)	0 (0.0%)
Overexertion		2 (1.9%)	2 (1.2%)	8 (9.0%)	1 (9.1%)
Collision with object		2 (1.9%)	5 (3.1%)	5 (5.6%)	0 (0.0%)
Collision with Person		9 (8.7%)	19 (11.7%)	3 (3.4%)	0 (0.0%)
Fall		85 (82.5%)	133 (82.1%)	72 (80.9%)	10 (90.9%)

Tables for different outcomes (Collision with person; Overexertion; Head and Neck Injury) by age groups

Exposure	Total	Collision person	Collision person%	RR	CI95	P
1-4	103	9	8.74	-	-	Ref
5-9	162	19	11.73	1.34	[0.63-2.85]	0.440
10-14	89	3	3.37	0.39	[0.11-1.38]	0.126
15-17	11	0	0.00	0.00	[.-.]	0.307

Exposure	Total	Overexertion	Overexertion%	Risk Ratio	CI95%	P
1-4	103	2	1.94	-	-	Ref
5-9	162	2	1.23	0.64	[0.09-4.44]	0.645
10-14	89	8	8.99	4.63	[1.01-21.24]	0.028
15-17	11	1	9.09	4.68	[0.46-47.57]	0.159

Exposure	Total	Head/Neck	Head/Neck%	RR	CI95	P
1-4	103	3	2.91	-	-	Ref
5-9	162	5	3.09	1.06	[0.26-4.34]	0.936
10-14	89	5	5.62	1.93	[0.47-7.85]	0.350
15-17	11	1	9.09	3.12	[0.35-27.50]	0.290

9.2 Are there any age groups among children at higher risk in trampoline parks? In terms of: injury severity (e.g. based on hospitalization rate)

Reference EU-IDB

- **Summary of Findings**

No Literature was found regarding this specific question.

From EU-IDB data, among those injured in Public Playgrounds and similar (aggregation described above) those aged 15-17 had a higher rate of Hospital Admissions 45% (statistically significant). Interpretation must consider that patients at this age may often not seek care for less severe injuries making overall proportion of admissions among this group higher. We believe attention should also be given to the possibility that this age group, specifically men are more prone to higher risk stunts as further evidence implies (see full report).

- **Literature Review**

No literature was found regarding this specific question

- **EU-IDB**

Proportion of Hospital admissions by Age Group in Public Playgrounds and similar

Exposure	Total	Hospital Admissions	AR%	Risk	Ratio	P
1-4	103	18	17.48	-	-	Ref
5-9	162	30	18.52	1.06	[0.62-1.80]	0.830
10-14	89	18	20.22	1.16	[0.64-2.08]	0.627
15-17	11	5	45.45	2.60	[1.20-5.63]	0.028

10. Are there any risk differences between trampoline parks and other locations where children are jumping on trampolines?

References 1,2,5,6,7,9,10; EU-IDB

- **Summary of Findings**

Some literature was found on risk differences related to specific topics as pointed up in previous questions (mechanisms and type of injury).

In one study Trampoline Park Injuries had more Hospital Admissions and More Surgical Interventions (statistically significant). Considering differences in Hospital admissions and other severity risks we found no further scientific literature.

From the EU IDB data we found that Public Playgrounds and Public Parks (aggregated) also had a statistically significant higher proportion of hospital admissions (19% vs 10%). After adjusting for confounding(factors with stronger association p>0.2), being in a Public Playground (aggregated) was associated with higher hospital admission and the association remained statistically significant.

We also found a lower proportion of brain injuries and head and neck injuries(all aggregated) but interpretation must be careful because head and neck injuries include

a wide range of type of injury and severity and as such hospital admissions should be considered the stronger proxy of injury severity.

Brain Concussion or mild traumatic brain injury (MTBI) is a condition in which there is a traumatically induced alteration in mental status, with or without an associated loss of consciousness . A broader definition is a traumatically induced physiologic disruption in brain function that is manifested by, memory loss, alteration of mental state or personality, or focal neurologic deficits. We found Concussions to be less common All other locations raising the hypothesis that this type of lesion is more common if there is a direct head impact with a hard surface which may be harder to happen in "Playgrounds and similar" and Public Parks.

- **Literature Review**

Doty J, Voskuil R, Davis C, et al. Trampoline-Related Injuries: A Comparison of Injuries Sustained at Commercial Jump Parks Versus Domestic Home Trampolines. J Am Acad Orthop Surg. 2019;27(1):23-31. doi:10.5435/JAAOS-D-17-00470

A retrospective review was performed evaluating domestic trampoline and commercial jump park injuries over a 2-year period. There were 439 trampoline injuries: 150 (34%) at jump parks versus 289 (66%) on home trampolines. The authors compared injuries in Trampoline Parks and Other Trampolines and found Trampoline Park Injuries had more Hospital Admissions and More Surgical Interventions(all ages) (borderline non statistically significant) (see table below)[10]

Comparison Between Trampoline-related Injuries From Jump Parks and From Home Trampolines (All Patients, Adult Patients, and Pediatric Patients)

Distribution	Jump Park	Home Trampoline	*P* Value[a]	OR[b]	95% CI
All ages (N = 439)	N = 150 (34%)	N = 289 (66%)	—	—	—
Total fractures and dislocations	83 (55%)	127 (44%)	**0.020**	1.58	1.061, 2.353
Lower extremity injuries	109 (73%)	130 (45%)	**<0.0001**	3.24	2.123, 5.007
Surgical intervention	19 (13%)	20 (7%)	0.052	1.95	0.995, 3.804
Emergency transport	18 (12%)	24 (8%)	0.220	1.50	0.778, 2.875
Hospital admission	13 (9%)	13 (4%)	0.090	2.01	0.893, 4.531
Adults (N = 69)	N = 40 (58%)	N = 29 (42%)	—	—	—
Total fractures and dislocations	18 (45%)	5 (17%)	**0.017**	3.85	1.253, 13.380
Lower extremity fractures/dislocations	17 (43%)	2 (7%)	**0.001**	9.68	2.264, 67.740
Surgical intervention	9 (23%)	3 (10%)	0.210	2.49	0.629, 12.420
Pediatrics (N = 370)	N = 110 (30%)	N = 260 (70%)	—	—	—
Total fractures and dislocations	65 (59%)	123 (47%)	**0.039**	1.61	1.024, 2.535
Lower extremity fractures/dislocations	47 (43%)	41 (16%)	**<0.0001**	3.97	2.397, 6.602
Surgical intervention	10 (9%)	17 (7%)	0.400	1.43	0.609, 3.219

Numbers in bold type denote statistically significant results, 95% CI.
CI = confidence interval, OR = odds ratio
[a] Mid-*P* exact test (2-tailed)
[b] Conditional maximum likelihood estimate of OR (crude)

- **EU-IDB**

The table below shows Proportion of different outcomes in Public Playground and similar and All other locations and presents PR and CI95%.

Admitted Hospital	**Total**	**Cases**	**Admitted to Hospital%**	**RR**	**IC95%**	**P**
All other Locations(inc unspecified)	1299	128	9.85	-	-	Ref
Public Playgrounds and Similar	365	71	19.45	1.97	[1.51-2.58]	0.000
Brain Injury	**Total**	**Cases**	**Brain Injury%**	**RR**	**IC95%**	**P**
All other Locations(inc unspecified)	1299	25	1.92	-	-	Ref
Public Playgrounds and Similar	365	0	0.00	0.00	[.-.]	0.008
Head/Neck	**Total**	**Cases**	**Head/Neck%**	**RR**	**IC95%**	**P**
All other Locations(inc unspecified)	1299	101	7.78	-	-	Ref
Public Playgrounds and Similar	365	14	3.84	0.49	[0.29-0.85]	0.009
Fractures	**Total**	**Cases**	**Fracture%**	**RR**	**IC95%**	**P**
All other Locations(inc unspecified)	1299	560	43.11	-	-	Ref
Public Playgrounds and Similar	365	185	50.68	1.18	[1.04-1.32]	0.010
Overexertion	**Total**	**Cases**	**Overexertion%**	**RR**	**IC95%**	**P**
All other Locations(inc unspecified)	1299	64	4.93	-	-	Ref
Public Playgrounds and Similar	365	13	3.56	0.72	[0.40-1.30]	0.273
Impact on Trampoline	**Total**	**Cases**	**Impact on Trampoline%**	**RR**	**IC95%**	**P**
All other Locations(inc unspecified)	1299	345	26.56	-	-	Ref
Public Playgrounds and Similar	365	91	24.93	0.94	[0.77-1.15]	0.532

Table. Multivariable analysis Logistic Regression variables with strongest association in bivariate analysis for the outcome Admitted to Hospital

Admited_Hospital	Adjusted Odds Ratio	Std. Err.	P>z	[95% Conf.	Interval]
Direct_Object2	.4519541	.1011759	0.000	.2914349	.7008855
Male	.7929995	.122762	0.134	.5854648	1.074101
Activity	1.251526	.2111518	0.184	.8991434	1.74201
Public Park(aggregate)	2.137732	.3514298	0.000	1.548892	2.950431
Overexertion	.1153661	.116984	0.033	.0158103	.8418154
Collision Object	.0949169	.0961041	0.020	.0130465	.6905449
Collision Person	.4827295	.1579074	0.026	.2542519	.9165231
_cons	.1575808	.0214928	0.000	.1206163	.2058737

After adjusting for confounding, being in a public park were associated with higher hospital admission and the association is statistically significant. The lesion being overexertion, collision with object or person and the trampoline being the direct object were statistically significant lower proportion of hospital admissions

Table Types of Injury in All Head and Neck Injuries

Head and Neck Injuries	Freq.	Percent	Cum.
Contusion/abrasion/open wound	53	46.09	46.09
Fracture	3	2.61	48.70
Distortion/sprain	20	17.39	66.09
Concussion	25	21.74	87.83
Other	14	12.17	100.00
Total	115	100.00	

Multivariable analysis Logistic Regression variables with strongest association in bivariate analysis with all Head and Neck Injuries

Head_Neck	Odds Ratio	Std. Err.	z	P>z	[95% Conf.	Interval]
Male	2.048561	.419677	3.50	0.000	1.371097	3.060763
AgeDIC	.9043574	.1900658	-0.48	0.632	.5990263	1.36532
Public Park	.4396149	.1298362	-2.78	0.005	.2464212	.7842723
ActDic	.8904739	.217013	-0.48	0.634	.5523052	1.435699
FallDic	1.167472	.0793394	2.28	0.023	1.021881	1.333807
Collision_Object	7.763477	8.354891	1.90	0.057	.9419136	63.98843
Overexertion	4.629496	5.250316	1.35	0.177	.501401	42.7447
Collision_Person	9.505524	10.21757	2.09	0.036	1.156145	78.15192
Hit Trampoline	2.355847	.5011789	4.03	0.000	1.552616	3.574623
_cons	.0050263	.0051947	-5.12	0.000	.000663	.0381036

Purpose III: Fatalities, permanent & temporary disabilities

Published data and research on Fatalities, permanent and temporary disabilities due to trampoline injuries is scarce.

In the initially selected studies (Figure 1.) deaths and severe cervical injury with disability was not systematically referred. When referred was reported in a small percentage of total.

From an epidemiological perspective, we selected and compiled data in those studies related to deaths/fatal injuries and cervical injuries or spinal cord injuries (when specified).

We must again refer that due to the heterogeneity of methods and presentation of results it is difficult to compile evidence from larger studies.

Among studies identified in the initial search strategy, studies that reported deaths/fatalities and cervical injuries are summarized below:

1. The US National Electronic Injury Surveillance System was queried for fractures occurring between 2008 and 2017 in individuals aged 0 to 17 years. Between 2008 and 2017, there was an estimated total of 989 338 paediatric trampoline-related ED visits. Fractures represented 26.9% (n = 266 373) of these visits. Neck injuries were estimated as 0.1% of all trampoline fractures[1]
2. In other study there were 2 cases of cervical spine fracture with spinal cord injury from 2010 to 2014 among 6932 trampoline fractures in the National Electronic Injury Surveillance System in the US.[2]
3. In Canada in eCHIRPP records for trampoline injuries (2012 to 2016) from a total of 5481 cases of home trampoline and 563 cases of trampoline park injuries[3] ,among spinal fracture cases (n=7 for BTI and n=1 for TPI), two cases were severe enough to require hospital admission, while for intracranial injury, one case required admission. The sole TPI spinal injury case involved an individual landing on their neck, while BTI spinal injuries occurred due to a variety of mechanisms and resulted in injuries ranging from soft tissue injury to nerve damage and dislocation.
4. In a nationwide retrospective cohort study in Korea for patients who visited emergency departments (EDs) after injuries during 2011–2016, 2799 patients with trampoline injuries visited EDs and there were 49 cervical spine injuries (no other specification) [4]
5. In a 6-month period in 2014, 40 children presented to one hospital department for injuries in indoor trampoline centers in Sidney. One child sustained an unstable cervical fracture/dislocation.[5]

In the EU-IDB no registry of death was found among injuries. However, selection bias must be considered as severe injuries may bypass the registry systems depending on implemented strategies in collaborating hospitals.

In EU-IDB among 1664 injuries reported from 2013 to 2016 (4 years) there were:

- 8 distortions of the cervical spine and 2 unspecified injuries
- 25 brain concussions
- 19 distortion/sprains of the neck
- 0 neck fractures
- 0 reported deaths

A separate search strategy was conducted specifically for death/fatalities, permanent and temporary disabilities.

Most peer-reviewed reports revolve around individual or low number case studies or case registries from specific hospitals. The individual circunstances and outcomes of such cases can be further analysed to inform risk management beyond the epidemiology of trampoline injuries in a more qualitative approach.

Studies that report severe cervical injury often identify somersaults and flips as an important risk factor. Often these injuries occurred landing on the trampoline mat. Poorly arranged foaming pits and landing incorrectly on foaming pits is also reported as a relevant mechanism in unpublished reports.

Other relevant, not identified in the initial search strategy are summarized below:

1. Patients younger than 18 years of age who presented to Stollery Children's Hospital (Edmonton, Alberta) between 1995 and 2006(11 years), with a cervical spine injury or death from trampoline use were identified via a medical records database search. There were 7 cases of cervical spine injury associated with trampoline use. Four patients had lasting neurological deficits at discharge from hospital, and another patient died at the scene due to refractory cardiac arrest. Injuries were sustained both on (n=5) and off (n=2) the trampoline mat from mechanisms that included attempted somersaults.[6]
2. From April to November 2015 in one Hospital in Finland (Oulu) there was a total of eight severe cervical spine injuries. Almost all severe trampoline injuries

resulted from an unsuccessful trick.[7]

3. In another prospective study in the Oulu region of Finland completed over 2 years (May 1, 2015 to April 31, 2017) there were 11 severely injured patients (10 boys). The annual incidence was 6.28/100,000 children <16 years of age. Mean age was 11.5 years. Severe injuries included five ligamentous cervical spine injuries and two sternal bone fractures. In addition, there were one lumbar spine ligament injury, two hip dislocations, and one severe axillary plexus nerve lesion. Eight out of 11 accidents were not seen by any adult and none of them happened under professional supervision.[8]
4. The U.S. Consumer Product Safety Commission announced that there were a total of 22 trampoline-related deaths in the 10-year period between 2000 and 2009.[9]

Although surveillance and monitoring of death and permanent disability resulting from trampoline use has limitations and may miss many cases, it is a rare outcome event among recent larger series of reported injuries. However they are events that can and must be prevented as they are mostly related to untrained, poorly supervised attempts of flips and somersaults.

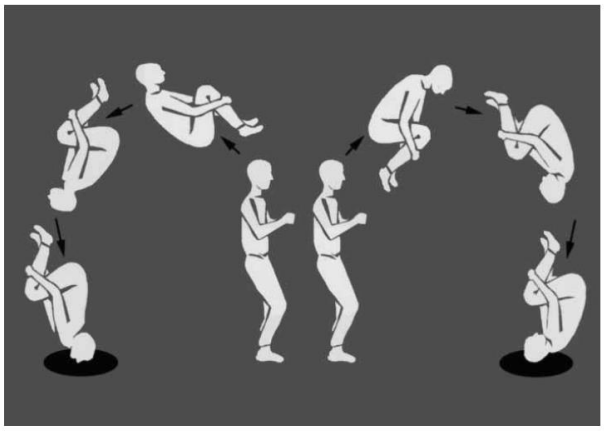


Fig. 3. The mechanism of cervical spine injuries typically involves hyperflexion from failed forward flips, or hyperextension from failed backward flips.

Source:(Brown et al)[10]

While cervical spine injury is fortunately not a commonly reported trampolining

injury, such injuries are a major cause of neurological sequelae and death related to trampoline use [6].

Cervical spine injuries frequently occur on the trampoline mat, rather than from a fall off the trampoline, often when failed flips or somersaults cause hyperflexion or hyperextension of the cervical spine[10] .

Review of several series reporting trampoline-induced quadriplegia show that the vast majority (82%) of these injuries involve fracture-dislocations of the lower cervical spine (below C4) [10]

In addition to cases reported in scientific publications, multiple cases of spinal cord injuries have been reported in the media, as well as a traumatic brain injury and deaths at trampoline parks. However it is not in the scope of our review to screen this type of sources.

References

1. Hadley-Miller N, Carry PM, Brazell CJ, Holmes KS, Georgopoulos G. Trends in Trampoline Fractures: 2008–2017. *Pediatrics*. 2020;145(1):e20190889. doi:10.1542/peds.2019-0889

2. Kasmire KE, Rogers SC, Sturm JJ. Trampoline Park and Home Trampoline Injuries. *Pediatrics*. 2016;138(3):e20161236-e20161236. doi:10.1542/peds.2016-1236

3. Rao DP, McFaull SR, Cheesman J, Do MT, Purcell LK, Thompson W. The ups and downs of trampolines: Injuries associated with backyard trampolines and trampoline parks. *Paediatr Child Health*. 2019;24(1):e19-e25. doi:10.1093/pch/pxy066

4. Choi ES, Jang JH, Woo J-H, Choi JU, Cho JS, Yang HJ. Pediatric Trampoline-Related Injuries in a Nationwide Registry in South Korea, 2011 to 2016. *Yonsei Med J*. 2018;59(8):989. doi:10.3349/ymj.2018.59.8.989

5. Mulligan CS, Adams S, Brown J. Paediatric injury from indoor trampoline centres. *Inj Prev*. 2017;23(5):352-354. doi:10.1136/injuryprev-2016-042071

6. Leonard H, Joffe AR. Children presenting to a Canadian hospital with trampoline-related cervical spine injuries. *Paediatr Child Health*. 2009;14(2):84-88. doi:10.1093/pch/14.2.84

7. Sinikumpu J-J, Salokorpi N, Suo-Palosaari M, Pesälä J, Serlo W. [Severe trampoline injuries and their risk factors among children and the young]. *Duodecim*. 2016;132(11):1061-1068. http://www.ncbi.nlm.nih.gov/pubmed/27400592. Accessed April 9, 2020.

8. Korhonen L, Salokorpi N, Suo-Palosaari M, Pesälä J, Serlo W, Sinikumpu J-J. Severe Trampoline Injuries: Incidence and Risk Factors in Children and Adolescents. *Eur J Pediatr Surg*. 2018;28(06):529-533. doi:10.1055/s-0037-1608676

9. US Consumer Product Safety Commission. National Electronic Injury Surveillance System. https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data. Accessed April 9, 2020.

10. Brown PG, Lee M. Trampoline injuries of the cervical spine. *Pediatr Neurosurg*. 2000;32(4):170-175. doi:10.1159/000028929

ANNEX 1

Analysis of EU-IDB 2013-2016 All Tables

Table1. Descriptive table of all variables in EU-IDB(original data, no recoding or grouping)

SEX	**Freq.**	**Percent**
Female	854	51.32
Male	810	48.68
AgeGroup	Freq.	Percent
1-4	401	24.10
5-9	698	41.95
10-14	497	29.87
15-17	68	4.09
PLACE_OCCUR	Freq.	Percent
unspecified place	1,042	62.62
Public playground	229	13.76
other specified place	211	12.68
Holiday park, campground	87	5.23
Amusement park/theme park	37	2.22
Other specified recreational area	23	1.38
Unspecified recreational area	21	1.26
Public park	12	0.72
Public building	2	0.12
ACTIVITY	Freq.	Percent
Leisure/play	888	53.37
Sports/exercise in leisure time	414	24.88
Unspecified	281	16.89
Others	81	4.87
TYPE_SPORT Freq.	Freq.	Percent
Trampoline/mini trampoline	362	87.65
Others/Unknown	51	

Not applicable	1251	
UNDER_OBJ	Freq.	Percent
Trampoline	1,567	95.14
Other	97	4.86
DIRECT_OBJ	Freq.	Percent
Trampoline	436	26.20
Other	176	10,60
Not filled	1052	63.20
Mech. of Inj.	Freq.	Percent
Fall	1,274	76.56
Collision with person	140	8.41
Collision with object	92	5.53
Unspecified	62	3.73
Acute over-exertion, over-extension	46	2.76
Other specified physical over-exertion	19	1.14
Unspecified physical over-exertion	12	0.72
Others	11	0.66
Crushing	8	0.48
TYPE_1	Freq.	Percent
Fracture	745	44.77
Contusion	384	23.08
Distortion/sprain	298	17.91
Unspecified	85	5.11
Open wound	35	2.10
Injury to blood vessels	33	1.98
Luxation/dislocation	29	1.74
Other	26	1.56
Concussion	23	1.38
No injury	4	0.24
Other specified brain injury	2	0.12
BODY_1	Freq.	Percent
Ankle	357	21.45
Lower leg	162	9.74
Foot	156	9.38

Elbow	149	8.95
Forearm	119	7.15
Wrist	116	6.97
Knee	88	5.29
Hand, fingers	86	5.17
Body part unspecified	83	4.99
Upper arm	82	4.93
Shoulder	35	2.10
Face	28	1.68
Brain	25	1.50
Abdomen, lower back, lumbar spine	25	1.50
Neck unspecified	24	1.44
Skull	20	1.20
Upper leg	18	1.08
Thorax	16	0.96
Neck, other	12	0.72
Cervical Spine	10	0.60
Thoracic Spine	9	0.54
Head, other	9	0.54
Lower extremities unspecified	9	0.54
Body part, other	8	0.48
Head unspecified	6	0.36
Others	12	0.72
TRT_FOLLOWUP		
A&E treatment	1,383	83.11
Admitted to Hospital	199	11.96
Discharge without treatment	66	3.97
Unknown	15	0.90
Other	1	0.06
Total	1,664	100.00
DAY_HOSP		
1-2	80	4.84
3-4	17	1.02
5-10	14	0.84

>10	3	0.18
Unknown	142	8.52
Not applicable/not filled	1408	84.60
TOTAL	1664	100.00

Table2. Bivariate analysis considering outcome Hospital Admissions.

		Exposed					
	Exposure	Total	Admitted to Hospital	AR%	RR	CI95	P
Age	1-4	401	48	11.97	-	-	Ref
	5-9	698	82	11.75	0.98	[0.70-1.37]	0.913
	10-14	497	57	11.47	0.96	[0.67-1.37]	0.816
	15-17	68	12	17.65	1.47	[0.83-2.63]	0.195
Sex	Female	854	95	11.1	-	-	Ref
	Male	810	104	12.84	1.15	[0.89-1.50]	0.281
Mechanism of Injury	Other/unspecified	81	9	11.11	-	-	Ref
	Overexertion	77	1	1.30	0.12	[0.02-0.90]	0.011
	Collision with object	92	1	1.09	0.10	[0.01-0.76]	0.005
	Collision with Person	140	11	7.86	0.71	[0.31-1.63]	0.417
	Fall	1274	177	13.89	1.25	[0.67-2.35]	0.480
Fracture	Fracture Yes/No	745	140	18.79	2.93	[2.19-3.91]	0.000
Brain Injury	Brain Injury Yes/No	25	12	48.00	4.21	[2.74-6.47]	0.000
Head/Neck Inj	Head_Neck Yes/No	115	23	20.00	1.76	[1.19-2.60]	0.006

Direct Object Trampoline	Direct_Objec Trampoline Yes/no	436	26	5.96	0.42	[0.28-0.63]	0.000
Place of occurrence	Other unspecified	1297	128	1.37	-	-	Ref
	Public playground	229	31	13.54	1.37	[0.95-1.98]	0.094
	Amusement park/theme park	37	9	24.32	2.46	[1.36-4.45]	0.004
	Public park	12	1	8.33	0.84	[0.13-5.55]	0.859
	Public building	2	0	0.00	0.00	[.-.]	0.640
	Holiday park, campground	87	30	34.48	3.49	[2.50-4.88]	0.000
Activity	Leisure/Play	414	62	14.98	-	-	Ref
	Sports/exercise in leisure time	888	104	11.71	0.78	[0.58-1.05]	0.100
	Others/unspecified	362	33	9.12	0.61	[0.41-0.91]	0.013
Type of Injury	Contusion/abrasion/open wound	419	16	3.82	-	-	Ref
	Fracture	745	140	18.79	4.92	[2.98-8.14]	0.000
	Luxation Dislocation	29	6	20.69	5.42	[2.29-12.80]	0.000
	Distortion/sprain	298	8	2.68	0.70	[0.30-1.62]	0.405
	Brain Concussion	25	12	48.00	12.57	[6.69-23.61]	0.000
	Others	144	17	11.81	3.09	[1.60-5.96]	0.000

Table3. Multivariable analysis Logistic Regression variables with strongest association in bivariate analysis for the outcome Admitted to Hospital

Admited_Hospital	Adjusted Odds Ratio	Std. Err.	P>z	[95% Conf.	Interval]
Hit Trampoline bed	.4519541	.1011759	0.000	.2914349	.7008855
Male	.7929995	.122762	0.134	.5854648	1.074101
ActDic	1.251526	.2111518	0.184	.8991434	1.74201
Public Park(aggregate)	2.137732	.3514298	0.000	1.548892	2.950431
Overexertion	.1153661	.116984	0.033	.0158103	.8418154
Collision Object	.0949169	.0961041	0.020	.0130465	.6905449
Collision Person	.4827295	.1579074	0.026	.2542519	.9165231
_cons	.1575808	.0214928	0.000	.1206163	.2058737

After adjusting for confounding, being in a public park were associated with higher hospital admission and the association is statistically significant. The lesion being overexertion, collision with object or person and the trampoline being the direct object were statistically significant lower proportion of hospital admissions

Multivariable analysis Logistic Regression variables with strongest association in bivariate analysis

Head Neck includes (

Head_Neck ?	Odds Ratio	Std. Err.	z	P>z	[95% Conf.	Interval]
Male	2.048561	.419677	3.50	0.000	1.371097	3.060763
AgeDIC	.9043574	.1900658	-0.48	0.632	.5990263	1.36532
Public Park	.4396149	.1298362	-2.78	0.005	.2464212	.7842723
ActDic	.8904739	.217013	-0.48	0.634	.5523052	1.435699
FallDic	1.167472	.0793394	2.28	0.023	1.021881	1.333807
Collision_Object	7.763477	8.354891	1.90	0.057	.9419136	63.98843
Overexertion	4.629496	5.250316	1.35	0.177	.501401	42.7447
Collision_Person	9.505524	10.21757	2.09	0.036	1.156145	78.15192
Direct_Object2	2.355847	.5011789	4.03	0.000	1.552616	3.574623
_cons	.0050263	.0051947	-5.12	0.000	.000663	.0381036

Considering the outcome all Head and Neck injuries after adjustment including more strongly associated variables in bivariable analysis we found that being a Male , having a collision with person or object, or the trampoline as a direct object were predictors of higher proportion of head and neck Injury. However the overall probability of having any type of head and neck inhury was smaller in Public Parks.

Table. Age by sex, all injuries. (n=1664)

AgeGroup	Male	Female	Total
1-4	178	223	401
	44.39	55.61	100.00
5-9	329	369	698
	47.13	52.87	100.00
10-14	263	234	497
	52.92	47.08	100.00
15-17	40	28	68
	58.82	41.18	100.00
Total	810	854	1,664
	48.68	51.32	100.00

Tabela Place of occurence by age (n=1664)

PLACE_OCCUR	1-4	5-9	10-14	15-17	Total
Public playground	72	108	46	3	229
	17.96	15.47	9.26	4.41	13.76
Amusement park/theme	10	14	10	3	37
	2.49	2.01	2.01	4.41	2.22
Public park	1	2	8	1	12
	0.25	0.29	1.61	1.47	0.72
Public building	0	1	1	0	2
	0.00	0.14	0.20	0.00	0.12
Holiday park, campgro	20	38	25	4	87
	4.99	5.44	5.03	5.88	5.23
Other specified recre	5	15	2	1	23
	1.25	2.15	0.40	1.47	1.38
Unspecified recreatio	7	9	5	0	21
	1.75	1.29	1.01	0.00	1.26
other specified place	47	106	51	7	211
	11.72	15.19	10.26	10.29	12.68
unspecified place	239	405	349	49	1,042
	59.60	58.02	70.22	72.06	62.62
Total	401	698	497	68	1,664
100.00	100.00	100.00	100.00	100.00	

Table Type of follow-up by age.

TRT_FOLLOWUP	1-4	5-9	10-14	15-17	Total
Discharge without tre	13	28	22	3	66
	3.24	4.01	4.43	4.41	3.97
A&E treatment	338	581	411	53	1,383
	84.29	83.24	82.70	77.94	83.11
Admited to Hospital	48	82	57	12	199
	11.97	11.75	11.47	17.65	11.96
Other	0	1	0	0	1
	0.00	0.14	0.00	0.00	0.06
Unknown	2	6	7	0	15
	0.50	0.86	1.41	0.00	0.90
Total	401	698	497	68	1,664
	100.00	100.00	100.00	100.00	100.00

Tabela Mechanisms of Lesion by age

Mech. of Inj.	1-4	5-9	10-14	15-17	Total
Others	2	4	5	0	11
	0.50	0.57	1.01	0.00	0.66
Collision with object	15	44	29	4	92
	3.74	6.30	5.84	5.88	5.53
Collision with person	34	66	34	6	140
	8.48	9.46	6.84	8.82	8.41
Crushing	1	4	3	0	8
	0.25	0.57	0.60	0.00	0.48
Fall	316	528	379	51	1,274
	78.80	75.64	76.26	75.00	76.56
Acute over-exertion,	10	13	21	2	46
	2.49	1.86	4.23	2.94	2.76
Other specified physi	1	6	9	3	19
	0.25	0.86	1.81	4.41	1.14

Unspecified physical	5	5	1	1	12
	1.25	0.72	0.20	1.47	0.72
Unspecified	17	28	16	1	62
	4.24	4.01	3.22	1.47	3.73
Total	401	698	497	68	1,664
	100.00	100.00	100.00	100.00	100.00

Table. Body part injured by age

BODY_1	1-4	5-9	10-14	15-17	Total
Face	5	16	5	2	28
	1.25	2.29	1.01	2.94	1.68
Brain	9	11	4	1	25
	2.24	1.58	0.80	1.47	1.50
Skull	8	7	3	2	20
	2.00	1.00	0.60	2.94	1.20
Cervical Spine	1	4	4	1	10
	0.25	0.57	0.80	1.47	0.60
Thoracic Spine	0	3	5	1	9
	0.00	0.43	1.01	1.47	0.54
Organs Trunk	0	1	0	0	1
	0.00	0.14	0.00	0.00	0.06
Thorax	1	6	9	0	16
	0.25	0.86	1.81	0.00	0.96
Abdomen,lower back,lu	1	9	12	3	25
	0.25	1.29	2.41	4.41	1.50
Collar bone	2	3	0	0	5
	0.50	0.43	0.00	0.00	0.30
Shoulder	6	6	22	1	35
	1.50	0.86	4.43	1.47	2.10
Upper arm	20	45	17	0	82
	4.99	6.45	3.42	0.00	4.93
Elbow	41	67	37	4	149
	10.22	9.60	7.44	5.88	8.95
Forearm	27	59	31	2	119
	6.73	8.45	6.24	2.94	7.15
Wrist	22	50	42	2	116
	5.49	7.16	8.45	2.94	6.97
Hand, fingers	4	33	44	5	86
	1.00	4.73	8.85	7.35	5.17
Hip	0	1	0	0	1
	0.00	0.14	0.00	0.00	0.06
Upper leg	8	8	1	1	18
	2.00	1.15	0.20	1.47	1.08
Knee	33	28	22	5	88

	8.23	4.01	4.43	7.35	5.29
Lower leg	109	29	20	4	162
	27.18	4.15	4.02	5.88	9.74
Ankle	41	185	111	20	357
	10.22	26.50	22.33	29.41	21.45
Foot	26	62	61	7	156
	6.48	8.88	12.27	10.29	9.38
Multiple body parts	0	1	0	0	1
	0.00	0.14	0.00	0.00	0.06
Whole body affected	0	0	1	0	1
	0.00	0.00	0.20	0.00	0.06
Head, other	4	4	1	0	9
	1.00	0.57	0.20	0.00	0.54
Head unspecified	3	2	0	1	6
	0.75	0.29	0.00	1.47	0.36
Neck, other	2	8	2	0	12
	0.50	1.15	0.40	0.00	0.72
Neck unspecified	2	9	10	3	24
	0.50	1.29	2.01	4.41	1.44
Upper extremities oth	0	1	1	0	2
	0.00	0.14	0.20	0.00	0.12
Upper extremeties uns	0	0	1	0	1
	0.00	0.00	0.20	0.00	0.06
Lower extremities uns	7	2	0	0	9
	1.75	0.29	0.00	0.00	0.54
Body part,other	0	3	4	1	8
	0.00	0.43	0.80	1.47	0.48
Body part unspecified	19	35	27	2	83
	4.74	5.01	5.43	2.94	4.99
Total	401	698	497	68	1,664
	100.00	100.00	100.00	100.00	100.00

TYPE_1	1-4	5-9	10-14	15-17	Total
No injury	0	1	3	0	4
	0.00	0.14	0.60	0.00	0.24
Constusion	98	148	121	17	384
	24.44	21.20	24.35	25.00	23.08
Open wound	7	15	9	4	35
	1.75	2.15	1.81	5.88	2.10
Fracture	211	306	208	20	745
	52.62	43.84	41.85	29.41	44.77
Luxation/dislocation	6	5	14	4	29
	1.50	0.72	2.82	5.88	1.74
Distorsion/sprain	45	146	95	12	298
	11.22	20.92	19.11	17.65	17.91
Concussion	8	10	4	1	23
	2.00	1.43	0.80	1.47	1.38
Other specified brain	1	1	0	0	2
	0.25	0.14	0.00	0.00	0.12
Injury to blood vess	2	14	13	4	33
	0.50	2.01	2.62	5.88	1.98

Other	3	12	7	4	26
	0.75	1.72	1.41	5.88	1.56
Unspecified	20	40	23	2	85
	4.99	5.73	4.63	2.94	5.11
Total	401	698	497	68	1,664
100.00	100.00	100.00	100.00	100.00	

Tabla Body Part and age (Fractures only)

BODY_1	**1-4**	**5-9**	**10-14**	**15-17**	**Total**
Face	1	1	3	0	5
	0.47	0.33	1.44	0.00	0.67
Thoracic Spine	0	2	1	0	3
	0.00	0.65	0.48	0.00	0.40
Thorax	0	2	2	0	4
	0.00	0.65	0.96	0.00	0.54
Abdomen,lower back,lu	0	0	1	2	3
	0.00	0.00	0.48	10.00	0.40
Collar bone	2	3	0	0	5
	0.95	0.98	0.00	0.00	0.67
Shoulder	4	4	12	1	21
	1.90	1.31	5.77	5.00	2.82
Upper arm	19	43	16	0	78
	9.00	14.05	7.69	0.00	10.47
Elbow	16	30	16	0	62
	7.58	9.80	7.69	0.00	8.32
Forearm	24	52	29	2	107
	11.37	16.99	13.94	10.00	14.36
Wrist	17	41	28	2	88
	8.06	13.40	13.46	10.00	11.81
Hand, fingers	2	23	24	0	49
	0.95	7.52	11.54	0.00	6.58
Upper leg	5	6	0	0	11
	2.37	1.96	0.00	0.00	1.48
Knee	10	4	2	0	16

	4.74	1.31	0.96	0.00	2.15
Lower leg	90	26	15	4	135
	42.65	8.50	7.21	20.00	18.12
Ankle	13	46	26	6	91
	6.16	15.03	12.50	30.00	12.21
Foot	8	23	31	3	65
	3.79	7.52	14.90	15.00	8.72
Body part,other	0	0	1	0	1
	0.00	0.00	0.48	0.00	0.13
Body part unspecified	0	0	1	0	1
	0.00	0.00	0.48	0.00	0.13
Total	211	306	208	20	745
	100.00	100.00	100.00	100.00	100.00

BODY_1	Contusion	Fracture	Luxation/	Distorsio	Concussio	Other	Total
Face	21	5	1	0	0	1	28
	75.00	17.86	3.57	0.00	0.00	3.57	100.00
Brain	0	0	0	0	25	0	25
	0.00	0.00	0.00	0.00	100.00	0.00	100.00
Skull	19	0	0	0	0	1	20
	95.00	0.00	0.00	0.00	0.00	5.00	100.00
Cervical Spine	0	0	0	8	0	2	10
	0.00	0.00	0.00	80.00	0.00	20.00	100.00
Thoracic Spine	4	3	0	1	0	1	9
	44.44	33.33	0.00	11.11	0.00	11.11	100.00
Organs Trunk	1	0	0	0	0	0	1
	100.00	0.00	0.00	0.00	0.00	0.00	100.00
Thorax	11	4	0	0	0	1	16
	68.75	25.00	0.00	0.00	0.00	6.25	100.00
Abdomen,lower back,lu	13	3	0	5	0	4	25
	52.00	12.00	0.00	20.00	0.00	16.00	100.00

Collar bone	0	5	0	0	0	0	5
	0.00	100.00	0.00	0.00	0.00	0.00	100.00
Shoulder	9	21	2	1	0	2	35
	25.71	60.00	5.71	2.86	0.00	5.71	100.00
Upper arm	4	78	0	0	0	0	82
	4.88	95.12	0.00	0.00	0.00	0.00	100.00
Elbow	48	62	17	17	0	5	149
	32.21	41.61	11.41	11.41	0.00	3.36	100.00
Forearm	10	107	0	1	0	1	119
	8.40	89.92	0.00	0.84	0.00	0.84	100.00
Wrist	19	88	0	7	0	2	116
	16.38	75.86	0.00	6.03	0.00	1.72	100.00
Hand, fingers	28	49	3	4	0	2	86
	32.56	56.98	3.49	4.65	0.00	2.33	100.00
Hip	1	0	0	0	0	0	1
	100.00	0.00	0.00	0.00	0.00	0.00	100.00
Upper leg	4	11	0	1	0	2	18
	22.22	61.11	0.00	5.56	0.00	11.11	100.00
Knee	37	16	4	25	0	6	88
	42.05	18.18	4.55	28.41	0.00	6.82	100.00
Lower leg	22	135	0	1	0	4	162
	13.58	83.33	0.00	0.62	0.00	2.47	100.00
Ankle	51	91	1	200	0	14	357
	14.29	25.49	0.28	56.02	0.00	3.92	100.00
Foot	72	65	1	16	0	2	156
	46.15	41.67	0.64	10.26	0.00	1.28	100.00
Multiple body parts	1	0	0	0	0	0	1
	100.00	0.00	0.00	0.00	0.00	0.00	100.00
Whole body affected	0	0	0	0	0	1	1
	0.00	0.00	0.00	0.00	0.00	100.00	100.00
Head, other	7	0	0	0	0	2	9
	77.78	0.00	0.00	0.00	0.00	22.22	100.00
Head unspecified	6	0	0	0	0	0	6
	100.00	0.00	0.00	0.00	0.00	0.00	100.00

Neck, other	4	0	0	6	0	2	12
	33.33	0.00	0.00	50.00	0.00	16.67	100.00
Neck unspecified	13	0	0	5	0	6	24
	54.17	0.00	0.00	20.83	0.00	25.00	100.00
Upper extremities oth	1	0	0	0	0	1	2
	50.00	0.00	0.00	0.00	0.00	50.00	100.00
Upper extremeties uns	1	0	0	0	0	0	1
	100.00	0.00	0.00	0.00	0.00	0.00	100.00
Lower extremities uns	6	0	0	0	0	3	9
	66.67	0.00	0.00	0.00	0.00	33.33	100.00
Body part,other	0	1	0	0	0	7	8
	0.00	12.50	0.00	0.00	0.00	87.50	100.00
Body part unspecified	6	1	0	0	0	72	79
	7.59	1.27	0.00	0.00	0.00	91.14	100.00
Total	419	745	29	298	25	144	1,660
	25.24	44.88	1.75	17.95	1.51	8.67	100.00

Table Injury by body Part

TYPE_1	Head	Neck	Trunk	Upper li	Lower Lim	Others	Total
Contusion/abrasion/op	53	17	29	120	193	7	419
	60.23	36.96	51.79	20.34	24.40	7.87	25.24
Fracture	5	0	15	405	318	2	745
	5.68	0.00	26.79	68.64	40.20	2.25	44.88
Luxation/dislocation	1	0	0	22	6	0	29
	1.14	0.00	0.00	3.73	0.76	0.00	1.75
Distorsion/sprain	0	19	6	30	243	0	298
	0.00	41.30	10.71	5.08	30.72	0.00	17.95
Concussion	25	0	0	0	0	0	25
	28.41	0.00	0.00	0.00	0.00	0.00	1.51
Other	4	10	6	13	31	80	144
	4.55	21.74	10.71	2.20	3.92	89.89	8.67

Total	88	46	56	590	791	89	1,660

Risk factors for Fractures

	Exposure	Total	Cases	AR%	Risk	Ratio	P
Mech	Other/unspecified	81	17	20.99			ref
Inj.	Overexertion	77	20	25.97	1.24	[0.70-2.18]	0.459
	Collision with object	92	24	26.09	1.24	[0.72-2.14]	0.431
	Collision with Person	140	58	41.43	1.97	[1.24-3.15]	0.002
	Fall	1274	626	49.14	2.34	[1.53-3.59]	0.000
Age	1-4	401	211	52.62			ref
	5-9	698	306	43.84		[0.74-0.94]	0.005
	10-14	497	208	41.85	0.80	[0.69-0.91]	0.001
	15-17	68	20	29.41	0.56	[0.38-0.82]	0.000
	Male	810	358	44.20	0.98	[0.88-1.09]	0.646
	ActDic	414	190	45.89	1.03	[0.92-1.17]	0.596
	Hit Trampoline	436	125	28.67	0.57	[0.48-0.67]	0.000

References

1. **Ashby K, Pointer S, Eager D, Day L. Australian trampoline injury patterns and trends. *Aust N Z J Public Health*. 2015;39(5):491-494. doi:10.1111/1753-6405.12404**

2. **Hadley-Miller N, Carry PM, Brazell CJ, Holmes KS, Georgopoulos G. Trends in Trampoline Fractures: 2008–2017. *Pediatrics*. December 2019:e20190889. doi:10.1542/peds.2019-0889**

3. **Karkenny AJ, Burton DA, Maguire KJ, Hanstein R, Otsuka NY. Do Professional Society Advocacy Campaigns Have an Impact on Pediatric Orthopaedic Injuries? *J Pediatr Orthop*. 2018;38(3):e122-e127. doi:10.1097/BPO.0000000000001133**

4. **Wilson G, Sameoto C, Fitzpatrick E, Hurley KF. Impact of a Canadian Pediatric Society Position Statement on Trampoline-related Injuries at IWK Health Centre, Halifax, Nova Scotia. *Cureus*. 2018;10(5):e2609. doi:10.7759/cureus.2609**

5. **Rao DP, McFaull SR, Cheesman J, Do MT, Purcell LK, Thompson W. The ups and downs of trampolines: Injuries associated with backyard trampolines and trampoline parks. *Paediatr Child Health*. 2019;24(1):e19-e25. doi:10.1093/pch/pxy066**

6. **Kasmire KE, Rogers SC, Sturm JJ. Trampoline Park and Home Trampoline Injuries. *Pediatrics*. 2016;138(3):e20161236-e20161236. doi:10.1542/peds.2016-1236**

7. **Choi ES, Jang JH, Woo J-H, Choi JU, Cho JS, Yang HJ. Pediatric Trampoline-Related Injuries in a Nationwide Registry in South Korea, 2011 to 2016. *Yonsei Med J*. 2018;59(8):989. doi:10.3349/ymj.2018.59.8.989**

8. **Meyerber M, Fraisse B, Dhalluin T, Ryckewaert A, Violas P. Trampoline injuries compared with other child activities. *Arch Pédiatrie*. 2019;26(5):282-284. doi:10.1016/j.arcped.2019.05.008**

9. **Korhonen L, Salokorpi N, Suo-Palosaari M, Pesälä J, Serlo W, Sinikumpu J-J. Severe Trampoline Injuries: Incidence and Risk Factors in Children and Adolescents. *Eur J Pediatr Surg*. 2018;28(06):529-533. doi:10.1055/s-0037-1608676**

10. **Doty J, Voskuil R, Davis C, et al. Trampoline-Related Injuries: A Comparison of Injuries Sustained at Commercial Jump Parks Versus Domestic Home Trampolines. *J Am Acad Orthop Surg*. 2019;27(1):23-31. doi:10.5435/JAAOS-D-17-00470**

11. **Roller. Trampoline Park Demographics and Data - August 2019 Insights. https://www.roller.software/blog/trampoline-park-demographics-and-data-the-latest-insights-august-2019. Published 2019. Accessed January 2, 2020.**

12. **Kirkwood G, Hughes TC, Pollock AM. Results on sports-related injuries in children from NHS emergency care dataset Oxfordshire pilot: an ecological study. *J R Soc Med*. 2019;112(3):109-118. doi:10.1177/0141076818808430**

13. **Roffe L, Pearson S, Sharr J, Ardagh M. The effect of trampoline parks on presentations to the Christchurch Emergency Department. *N Z Med J*. 2018;131(1468):43-53. http://www.ncbi.nlm.nih.gov/pubmed/29346356. Accessed December 23, 2019.**

14. **Mulligan CS, Adams S, Brown J. Paediatric injury from indoor trampoline centres. *Inj Prev*. 2017;23(5):352-354. doi:10.1136/injuryprev-2016-042071**

15. **Menelaws S, Bogacz AR, Drew T, Paterson BC. Trampoline-related injuries in children: A preliminary biomechanical model of multiple users. *Emerg Med J*. 2011;28(7):594-598. doi:10.1136/emj.2009.085803**

16. **Thi Huynh AN, Andersen MM, Petersen P, Hansen TB, Kirkegaard H, Weile JB. Childhood trampoline injuries. *Dan Med J*. 2018;65(11). http://www.ncbi.nlm.nih.gov/pubmed/30382018. Accessed December 12, 2019.**