



Trampoline Injuries:

A summary of current understanding to inform local responses

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April 2011

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1. Introduction

Avonsafe

1.1 Avonsafe was formed in 1996 as a partnership of organisations who work to reduce unintentional injuries in the West of England. It is steered by NHS Bristol, NHS South Gloucestershire, NHS North Somerset and NHS Bath and North East Somerset who jointly fund an Avonsafe Co-ordinator post and employ local injury prevention posts to deliver local interventions.

1.2 The prevention of every minor injury is not Avonsafe's aim: partners concentrate on the most serious injuries and that are most likely to have long term consequences, especially those that result in emergency admission to a hospital bed. Avonsafe currently prioritises work with people aged over 65 and under 18 (particularly under 5) who are the most vulnerable age groups.

Falls from playground equipment

1.3 In Avon, falls from playground equipment cause a significant number of serious injuries to under 18 year old children. Table 1 presents numbers and rate of injuries requiring emergency admission to a hospital bed that are too serious to be treated in outpatients departments.

		2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10
North Somerset	Pop	40,817	41,118	41,569	41,846	42,136	41,832	43,100
	N ^o	17	23	25	33	32	28	43
	Rate	4.16	5.59	6.01	7.89	7.59	6.69	9.98
Bristol	Pop	80,625	79,817	79,498	78,824	78,756	77,382	79,800
	N ^o	47	56	57	74	54	59	61
	Rate	5.83	7.02	7.17	9.39	6.86	7.62	7.64
South Gloucestershire	Pop	56,867	56,850	56,698	56,534	56,564	56,450	56,400
	N ^o	40	33	29	36	49	49	54
	Rate	7.03	5.80	5.11	6.37	8.66	8.68	9.57
Bath and North East Somerset	Pop	34,911	34,842	34,747	34,555	34,513	34,310	34,300
	N ^o	37	23	30	28	33	27	23
	Rate	10.60	6.60	8.63	8.10	9.56	7.87	6.71

Table 1: Emergency admission numbers and rate per 10,000 as a result of falls from playground equipment in under 18 year old residents of Avon.

	Bristol	Banes	South Gloucestershire	North Somerset
All RTCs	984	331	683	336
All burns and scalds	334	53	128	76
Accidental poisoning	359	129	122	79
Falls from playground equipment	408	201	290	201

Table 2: Comparison of numbers of admissions between 2003/04 and 2009/10

1.4 'Playground equipment' has specific connotations and in many peoples minds creates an image of swings, roundabouts and climbing frames located in municipal parks and maintained by the local authority. But playground equipment will also include private equipment located (for example) in the grounds of public houses, at leisure facilities and at home.

Trampolining in the USA

1.5 The modern trampoline was invented in the United States in 1936, and following increasing interest in the devices as sports equipment and training tools for (amongst others) astronauts, the sport was incorporated into the Olympics in 2000. Most of the work on trampoline safety has been led from within the USA, where the US National Electronic Injury Surveillance System (NEISS) online database, managed by The US Consumer Product Safety Commission (CPSC) has enabled details of the increase in injury numbers to be recorded. There is no analogous system in England.

1.6 The rapid rise in trampoline injuries came to light during the 1990's when sales for use at home took off. Between 1990 and 1995, the numbers of trampoline related injuries that were treated in hospital increased from 29,600 to 58,400. Commentators described this as an 'epidemic' and called for the sale of backyard trampolines to be banned immediately¹.

"I think it is time to say that trampolines are simply unsafe for the home setting. Home trampoline use is something that we should consider unsafe for children, and it should be stopped.

"This is a public health problem that needs to be addressed with stronger strategies than those currently in place."

Smith, (1995)

1.7 In the USA, eleven (11) deaths were reported between 1990 and 1999².

1.8 The clamour for action to improve trampoline safety at the end of the 1990s led to improvements to the safety standards for home trampolines sold in the USA, including in 2003 a new standard for enclosures.

1.9 But injuries have continued to rise: the 89,360 emergency department presentations had in 2002 had risen to 107,435 by 2007³.

1.10 The American Association of Paediatrics continue to argue that trampolines should not be used at home.

¹ **Smith G A** (1998) *Injuries to children in the United States related to trampolines: 1990-1995: A national epidemic*. Paediatrics 101 406-12.

² **U.S. Consumer Product Safety Commission (CPSC)**

³ **Alexander, K. Eager, D. Scarrott, C. Sushinsky, G.** (2010) *Effectiveness of pads and enclosures as safety interventions on consumer trampolines*. Injury Prevention 16: 185-189.

2. The story in the UK/Avon

2.1 The data available in the UK on trampoline injuries is sparse. The most up to date estimates of injuries at home are available from the Home and Leisure Safety Survey last conducted in 2002. This shows 11,500 people in the UK going to hospital after an accident with a trampoline – an increase of more than 50 per cent between 1997 and 2002. In 2003, 40,000 home trampolines were sold in the UK. By 2004, sales had increased to 120,000 units⁴ and a “worrying trend” in trampoline related injuries was recorded in 2006⁵.

2.2 Hospital Episode Statistics (see table 1) that record the most serious injuries requiring admission to a hospital bed do not capture injuries treated by emergency department attendance, but we can estimate attendance numbers. Studies have recorded that between 3%¹ and 13%⁷ of injured children are admitted to hospital. Based on 163 emergency admissions in Avon in 2009/10, this would suggest between 1,253 and 5,433 injuries result from falling from playground equipment and were treated in emergency departments in Avon that year.

2.3 But the number of emergency admissions caused by trampolines is unknown. Discussions with local authorities in the area would suggest that very few injuries are occurring on municipal playgrounds, but this is yet to be evidenced.

2.4 Whether the majority of trampoline injuries that do not result from a fall (see paragraphs 3.9 and 3.10 below) are coded as “fall from playground equipment” needs to be established.

2.5 As yet, there's no British Manufacturing Standard for domestic, home and garden trampolines, but commercial models should meet BS EN 13219:2008 *Gymnastic equipment. Trampolines. Functional and safety requirements, test methods* .

⁴ **Wotton, M. and Harris, D. (2009)** *Trampolining injuries presenting to a children's emergency department*. Emerg Med J 2009;26:728–731. doi:10.1136/emj.2008.069344

⁵ **K Bhangal, D Neen, R Dodds (2006)** *Incidence of trampoline related pediatric fractures in a large district general hospital in the United Kingdom: lessons to be learnt*. Injury Prevention 2006;12:133–134. doi: 10.1136/ip.2005.010314

3. Causes of injuries

3.1 A search of *You Tube* (www.youtube.com) for “trampolining injuries” reveals a rather ghastly case series that demonstrates how some injuries have occurred in real life. The video sample is interesting when viewed in the context of studies that have categorised injury causes and brings to life the effects described below.

More than one person on the trampoline at one time.

Factor	Prevalence of injury, Ninewells Hospital study (n=50)	RoSPA guidance
Multiple users	80%	74% of injuries associated with multiple users
Lack of adult supervision	46%	Adult “spotter” reduces risk of injury
Lack of safety net	64%	Safety net reduces chance of child falling to ground
Site of injury	54% legs 32% arms 14% head, neck, face, chest	Injuries seen in all parts of the body, including neck, arms, legs, face, and head

Table 3: Factors in trampolining injuries (Bogacz, et al 2009).

3.2 “[Table 3] shows that the most important factor associated with trampoline injury is having many users on a trampoline at one time. RoSPA reports that the lightest person is five times more likely to be injured. We have found that the severity of the injury also increases with the mismatch between child and adult weights. For example, a child of 20 kg can experience a force equivalent to a 3.5 m fall when bouncing with an adult of 80 kg (S Menelaws et al, spring scientific conference of the College of Emergency Medicine, April 2009)⁶”.

Bogacz, et al (2009)

3.3 Newton’s analysis of 70 trampolining injuries requiring surgery at Weston General Hospital in North Somerset, England during nine months of 2007 confirms the hazard posed by multiple users: almost half (47%) involved another child jumping at the same time. Wotton and Harris found that in 82% of cases the injured child was not the only person on the trampoline at the time.

⁶ Bogacz, A. Paterson, B and Babber, A. (2009) *Trampoline injuries: How to avoid injury*. Letter to BMJ 2009; 338:b2197

3.4 RoSPA suggests that “approximately 75% of injuries occur when more than one person is on the trampoline. The person weighing less is five times more likely to be injured”.

3.5 If a trampolinist lands on the mat when out of phase with the other participants, the mat may be rising to meet them and the effect is of meeting a hard surface. All the potential and kinetic energy in the system is transferred to the person, who may be unprepared. Depending on the child’s mass, the energy transfer may be equivalent to falling from 2.2m or 3.4 m equivalent to a fall from a first floor window⁷. This fact may provide a useful tool to communicate the effect of trampolining to parents and supervisors.

3.6 Collisions between multiple users are also reported as a cause of injury by Alexander, 2010 and Nysted (2009). For example “brother fell on patients arm and patient heard a crack’ This category accounts for 10% of all trampoline injuries included in Alexanders study.

Kipping and kabooming

Multiple users pose a hazard because of a phenonomon called ‘kipping’. This is the enhanced uplift that results from the bed being compressed slightly before the main performer or gymnast lands on the same surface causing the bed to be recoiling (moving upwards) when the performer lands. The effect is applied to create a trampolining effect known as a “kaboom” in which a performer can create the enhanced uplift him/herself by landing one part of the body (e.g., upper torso) slightly ahead of the lower legs. When this is done while facing up towards the ceiling, the net effect is to propel the legs upwards with much greater momentum than the upper body receives, and the performer rotates into a backward somersault. The hazard is magnified when uncontrolled kipping occurs with multiple users.

(Milmer, 2009 – Rapid Response to *BMJ* 2009;338:b2197)

Inadequate supervision

3.6 According to Bogacz, et al (2009), “adult supervision is crucial in preventing trampoline injuries. The most influential role of a supervising adult is to ensure safety guidelines are followed, exuberance is controlled, and help is provided with setting up and dismounting from the trampoline”.

3.7 But “adult supervision is no guarantee of safety. More than half of all trampoline accidents occur whilst under supervision. However a trained ‘spotter’ can greatly reduce this risk”, (RoSPA). Note that RoSPA emphasises the role of trained spotters.

⁷ Menelaws, S. Bogacz, A.R, Drew, T. and Paterson B.C. (2010) *Trampoline related injuries in children: a preliminary biomechanical model of multiple users*. Journal of Emergency Medicine

3.8 In the USA standards prohibit the sale of trampolines packaged with ladders that may enable children under 6 years to climb onto and use a trampoline without an adult being present.

Lack of safety net?

3.9 Wotton, et. al. (2009) found that 68% of injuries associated with trampolining in their study did not involve a fall from the trampoline.

3.10 A study of injuries occurring in New Zealand between 1979-1988 found that 80% of injuries occurred from falling from the trampoline⁸. But large studies by Nysted, 2006 and Alexander found much lower proportions of 22% and 27% respectively, very close to the 28% figure produced by both Furnival et al⁹ and Larson and Davis¹⁰. The wide difference between the New Zealand study and the others is not explained, but may be related to its use of ICD coding that limits the descriptions of the circumstances in which injuries occurred, compared to other studies that have captured more detailed descriptions captured from retrospective interviews with those involved.

3.11 'Falling off' does not appear to be the cause of the majority of trampolining injuries, but is the type of cause most likely to be countered by the employment of effective safety nets.

3.12 The introduction of safety nets following issuing of patents in 2001 made 'no measurable change' to injury statistics in the USA, (Alexander, 2009). The study suggests the following reasons for the failure of the safety measures to have any impact: they simply do not work; they are ignored and non-compliant trampolines are being sold; the inclusion of safety nets is not mandatory; compliant trampolines are sold, but are not assembled and used correctly; the majority of trampolines in use were purchased before the standards were improved and / or the trampolines and safety measures deteriorate quickly and become ineffective.

3.13 In the UK, Wotton and Harris noted that in 41% injuries, safety equipment was present, and that "the presence of safety equipment did not appear to correlate inversely with the likely hood of injury occurring".

3.14 Counter to these findings, Newton's smaller study of 70 injuries found an association between reduced risk of injury and use of safety nets.

Too young

3.15. Young children are lighter, and less likely to have sufficient motor coordination skills to stabilise themselves in order to control landings and take off. Patients less than 5 are more likely to present with a fracture than the

⁸ Chalmers, D. et al (1994). *Trampolines in New Zealand: A Decade of Injuries*. Br J of Sp Med 1994 28(4)

⁹ Furnival RA, Street KA, Schunk JE. (1999). *Too many trampoline injuries*. Pediatrics 1999;103:1020–5.

¹⁰ Larson BJ, Davis JW. (1995). *Trampoline-related injuries*. J Bone Joint Surg Am;77:1174–8.

population as a whole and 50% more likely to require surgery for their injury⁵. Injuries caused by fall from the trampoline are more serious than those caused by contact with the pad; given the increased likelihood of small children to lose control and be propelled from the pad this may help explain the greater proportion of more severe injuries in this group.

3.16 Manufacturers, the USA Consumer Protection Safety Council and the Royal Society for the Prevention of Accidents all advise that children under the age of 6 should not be allowed on trampolines over 20 inches in height or of a diameter of more than 10 feet,^{11, 12}.

Pads and springs

3.17 Alexander's study of 2160 injuries in the USA between 2002 and 2007, found that 19% of all trampoline injuries were caused by contact with frame and / or springs, and injuries involved fractures, lacerations and contusions as well as dental and head injuries.

3.18 The same study of the effectiveness of pads and enclosures concluded that: "the advent of enclosures in 1997 and the ASTM standards upgrades in 1999 to improve padding have to this point made no measurable change to trampolining injury statistics", possibly for the same reasons outlined above in relation to enclosures.

4. Interventions to reduce injury

4.1 Warning campaigns

Organisations with an interest in child welfare and injury prevention on occasion attempt to highlight the injuries that occur on trampolines in order to raise awareness of safety messages. Three fairly typical examples are:

- 1) Local Government Association, 2008¹³
- 2) Dundee doctors issue trampoline warning¹⁴ and
- 3) Warning follows trampoline rise in Northern Ireland¹⁵

¹¹ Royal Society for the Prevention of Accidents *Trampoline Safety* www. ROSPA.com

¹² US Consumer Product Safety Commission (CPSC) *Trampolines* September 2000.

¹³ Councils issue safety warnings as trampoline injuries jump LGA press release - 14 August 2008

¹⁴ <http://news.stv.tv/scotland/tayside/100231-dundee-doctors-issue-trampoline-warning/>

¹⁵ http://news.bbc.co.uk/1/hi/northern_ireland/5109574.stm

1) Local Government Association, 2008

Cllr Hazel Harding, Chair of the Safer Communities Board of the Local Government Association, a cross-party organisation representing over 400 councils in England, said:

"Trampolines are great fun for children and a fantastic way of keeping fit, but they can be dangerous if not used properly.

"Sales of trampolines are soaring and so is the number of youngsters being injured on them. Councils help get people safely through the day and are urging parents to follow a few simple safety rules to ensure that children who use trampolines enjoy a happy, accident-free summer."

2) Dundee Doctors issue trampoline warning

The findings of the Ninewalls Study reported in Bogtacz et al (2009) achieved significant press coverage in Scotland, including points about the equivalent fall height later reported in Menelaws and Bogtacz (2010).

3) Warning follows trampoline rise in Northern Ireland¹⁶

"A "trampoline craze" across Northern Ireland could kill a child, a consultant at Newry's Daisy Hill Hospital has warned.

Michael McCann said in just one month, almost 100 people had to be treated for injuries sustained using trampolines. The medical expert said safety measures were important when using trampolines at home. The most common type of injuries were sprains, but there were more serious fractures which could "lead to long-standing disability".

About 20% of people injured are under the age of five and safety nets had a limited effect on reducing the number of injuries, said Mr McCann.

"Many of the injuries are caused by having multiple users on the trampoline - it is a recipe for disaster," he said.

"When there is a small child and a larger child on a trampoline, the smaller child often ends up coming to grief because of the larger child landing on it." Mr McCann said: "People have to be aware of the risks and I think people should have the information and then decide if the risks are worth the benefits."

¹⁶ http://news.bbc.co.uk/1/hi/northern_ireland/5109574.stm

4.2 Guidelines for safe use

Many checklists of safety advice have been published, but it seems that these guidelines are being 'summarily ignored by parents and children alike' ⁵.

The wording of recommendations and guidelines varies. Some have advocated a complete ban¹, and others that trampolines are not suitable as 'play equipment' and should not be sold or used as such⁸. Most accept that the use of equipment already sold will now continue, and focus on providing safety tips to reduce the numbers of serious injuries that will result as a consequence (RoSPA, Trampoline Safety). One example is reproduced below. This has been selected for it reflects many of the findings reported in the studies discussed above, particularly its summary of the effectiveness (or otherwise) of nets. RoSPA's guideline contains more detailed advice about locating and using trampolines.

USA's Foundation for Spinal Cord Injury Prevention, Care and Cure.

Trampoline Safety Tips

- **Trampolines should not be used except when there is adequately trained supervision for the recreational activity.**
- **Trampolines should only be used in well-lighted areas and children should never be allowed to jump onto the trampoline from high objects.**
- **A surrounding net may decrease the injury rate but this has not been extensively proven yet. There is netting now available around the perimeter of trampolines. This netting has been shown to reduce the number of injuries from falls off the trampoline but should only be used with the following warnings: 1) Netting is not a substitute for adequate adult supervision; 2) Netting will not reduce nor eliminate crippling injuries and death on the surface of the trampoline itself. It has been shown to retain users in the trampoline area and for that reason alone is recommended.**
- **The trampoline jumping surface should be placed at ground level.**
- **The supporting bars, strings and surrounding landing surfaces should have adequate protective padding.**
- **Only one participant should use a trampoline at any time.**
- **Trained spotters should be present when participants are jumping.**
- **Somersaults or high-risk manoeuvres should be avoided without proper supervision and instruction; these manoeuvres should be**

done only with proper use of protective equipment, such as a harness.

- Use of trampolines for physical education, competitive gymnastics, diving training and other similar activities requires carefully trained adult supervision and proper safety measures
- Competent adult supervision and instruction is needed for children at all times.

www.fscip.org/tramp.html#facts

4.3 Instructional methods and programmes

Wakefield Council

www.wakefield.gov.uk/CultureAndLeisure/LeisureFacilities/Trampoline.htm

Brilliantly combining the agendas of encouraging activity and reducing injuries at the same time, Wakefield gave away free 1-hour trampoline lessons for “children and young people aged between 7 and 16 years living in the Wakefield district, who have never attended a trampoline lesson or programme and intend to use a trampoline during this summer period.

Train parents to provide effective supervision – challenge trampolining myths

No examples of training projects have been found, but supervision clearly involves more than simply being present. Knowing what behaviours are associated with injury, how to set up a trampoline to reduce risk and an understanding of trampolining technique may help parents to take a more active and supportive role in helping children enjoy and improve their trampolining skills while at the same time reducing risk of serious injury.

Myths

Menelaws reports that in their study parents attending emergency departments with their children had on occasion purchased large trampolines with the intention of simultaneous multi-person use, believing that large trampolines are designed for that purpose.

The perception of hazard is likely to be that falling from the trampoline is the main risk to child health, but this is not the case as studies listed above have shown. Linked to this will be the belief that if nets and pads are in use, then injury risk is minimised, but as Alexander et al have shown, pads and enclosures have not been effective in reducing injury.

5. AVONSAFES (DRAFT) TRAMPOLINE INJURY REDUCTION STRATEGY

The strategy has been shaped by the following considerations:

1. The use of trampolines already located in back gardens in the Avonsafe area will lead to injuries, some of which will be serious, all of which are avoidable, none of which are desirable.
2. While the activity of trampolining has benefits for the participants, the injuries that will result do not.
3. Evidence suggests that the following factors are likely to lead to increased risk of serious injury:
 - a. More than one person using the trampoline at the same time
 - b. Inadequate (untrained) supervision
 - c. Trampoline is not set up or located properly
 - d. Child too young (less than 6 years)

Avonsafe will:

- Work with partners to encourage active lifestyles
- Raise awareness of the inherent hazards posed by trampolines
- Advocate rejecting purchase of trampolines for home use in favour of joining trampolining clubs that have trained supervisors and appropriate safety equipment
- When home use cannot be substituted with proper facilities then Avonsafe will promote trampoline safety tips based on those drafted by the USA's Foundation for Spinal Cord Injury Prevention, Care and Cure and / or the Royal Society for the Prevention of Accidents as appropriate.

In practice, this will involve Avonsafe members in joint activities with leisure centres, clubs and local authority staff to teach children and parents about the benefits of an active lifestyle and how these benefits may be achieved while minimising the risk of serious injury from trampoline use.