



## POLICY STATEMENT

# Cheerleading Injuries: Epidemiology and Recommendations for Prevention

## abstract

FREE

Over the last 30 years, cheerleading has increased dramatically in popularity and has evolved from leading the crowd in cheers at sporting events into a competitive, year-round sport involving complex acrobatic stunts and tumbling. Consequently, cheerleading injuries have steadily increased over the years in both number and severity. Sprains and strains to the lower extremities are the most common injuries. Although the overall injury rate remains relatively low, cheerleading has accounted for approximately 66% of all catastrophic injuries in high school girl athletes over the past 25 years. Risk factors for injuries in cheerleading include higher BMI, previous injury, cheering on harder surfaces, performing stunts, and supervision by a coach with low level of training and experience. This policy statement describes the epidemiology of cheerleading injuries and provides recommendations for injury prevention. *Pediatrics* 2012;130:966–971

## INTRODUCTION

When cheerleading originated in the late 1800s,<sup>1</sup> the primary purpose was to lead the crowd in cheering on sports teams through the use of pompoms, toe-touch jumps, splits, and clapping. However, over the last century, cheerleading has evolved dramatically into a competitive, physically demanding, year-round activity consisting of fast-paced floor routines with leaps and jumps, gymnastics-style tumbling, and complex stunts, such as pyramid building and tossing athletes in the air (see Appendix for definitions of cheerleading terminology). Cheerleading has also become much more popular. From 1990 to 2003, the number of US cheerleaders 6 years and older increased by approximately 600 000 from 3.0 to 3.6 million.<sup>2</sup> This number includes traditional school-based cheerleading squads as well as “all-star” cheerleading squads, which are not associated with a school or sports league and whose main objective is competition. In 2009, the National Federation of State High School Associations (NFHS) reported that there were approximately 400 000 participants in high school cheerleading, with approximately 123 000 on competitive cheer teams.<sup>3,4</sup> Girls represent the majority (96%) of participants.<sup>5</sup> With this growth in participation and the more physically demanding routines comes a greater number of injuries and, subsequently, an increase in the number of cheerleaders presenting to the pediatrician for treatment and advice about prevention.

COUNCIL ON SPORTS MEDICINE AND FITNESS

**KEY WORDS**

cheer, athletes, sports, adolescents, females

**ABBREVIATIONS**

AACCA—American Association of Cheerleading Coaches and Advisors

NCAA—National Collegiate Athletic Association

NFHS—National Federation of State High School Associations

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## EPIDEMIOLOGY OF INJURIES

Although most high schools and colleges have cheerleaders, only 29 state high school athletic associations recognize cheerleading as a sport,<sup>3</sup> and the National Collegiate Athletic Association (NCAA) does not include competitive cheerleading in its list of sponsored sports. This has important implications on injury rates and prevention, because being classified as a sport affords valuable safety resources and regulations, such as qualified coaches, adequate and well-maintained practice facilities, preseason conditioning, access to certified athletic trainers and team physicians, and mandated preparticipation physical examinations. It also means injury data for cheerleaders are not uniformly captured in the sports injury surveillance systems of state high school athletic associations, the NFHS, and the NCAA. Fortunately, a few epidemiologic studies completed in recent years have provided some data on cheerleading injuries. The data presented here do not include dance teams, baton, or color guard.

Cheerleading injuries in the United States have been increasing steadily over the past few decades. The US Consumer Product Safety Commission reported 4954 hospital emergency department visits for cheerleading injuries in 1980.<sup>6</sup> By 2007, the Consumer Product Safety Commission reported this number had climbed more than 400% to 26 786. Although 98% of injured cheerleaders were treated and released, 221 were hospitalized.

The number of catastrophic injuries related to cheerleading has increased from 1.5 per year from 1982 to 1992 to 4.8 per year from 2003 to 2009.<sup>7</sup> This rising incidence of injury is likely attributable to a combination of (1) larger numbers of children, as young

as 3 years of age, participating in cheerleading classes and teams; (2) incorporation of more complex skills, including tumbling, pyramids of 15 ft or higher, and partner stunts with athletes lifting, tossing, and catching each other; and (3) better reporting of cheerleading injuries through a few recent epidemiologic studies and a case report.

The overall injury rate in cheerleading across all age groups is 1.0 per 1000 athletic exposures. An athletic exposure is defined as 1 athlete participating in 1 practice or competition session. College cheerleaders have the highest injury rate (2.4), followed by elementary school (1.5), high school (0.9), all-star (0.8), middle school (0.5), and recreational (0.5) cheerleaders. The overall injury rate in high school cheerleading is lower than in other girls' high school sports (Table 1).<sup>5,8</sup>

As in other sports, cheerleading injury rates increase with age and competitive level.<sup>5,9</sup> Middle and high school cheerleaders have lower overall rates of injury than do collegiate cheerleaders (0.5 and 0.9 vs 2.4 per 1000 athletic exposures, respectively).<sup>5</sup> This is probably because older, better-skilled cheerleaders perform more complex gymnastics and height-based stunts. Rates of stunt-related injuries

are higher for collegiate versus high school and middle school cheerleaders (1.59 vs 0.59 and 0.23 per 1000 athlete exposures, respectively).<sup>10</sup>

## INJURY MECHANISMS

The most common mechanisms of injury are basing/spotting (23%), tumbling (14%–26%), and falls from heights (14%–25%).<sup>5,11</sup> Stunting accounts for 42% to 60% of all cheerleading injuries and 96% of concussions and closed-head injuries.<sup>10,12,13</sup> Pyramid stunts are responsible for the majority of head/neck injuries (50%–66%).<sup>14,15</sup>

## TYPES OF INJURIES

When all age groups are considered together, lower-extremity injuries are most common (30%–37% of all cheerleading injuries), followed by injuries to the upper extremities (21%–26%), head/neck (16%–19%), and trunk (7%–17%).<sup>5,7,9,15</sup> Younger cheerleaders are more likely to experience upper-extremity injuries (41% vs 25% of all injuries for 6- to 11-year-olds vs 12- to 17-year-olds, respectively), and older cheerleaders are more likely to have lower-extremity injuries (38% vs 29% of all injuries for 12- to 17-year-olds vs 6- to 11-year-olds).<sup>9</sup>

Overall, sprains and strains are the most common types of injuries (53% of all cheerleading injuries), followed by abrasions/contusions/hematomas (13%–18%), fractures/dislocations (10%–16%), lacerations/punctures (4%), and concussion/head injuries (3.5%–4%).<sup>5,9</sup> A single case report reveals a cheerleader with a splenic rupture after being thrown in the air and caught by a fellow cheerleader in a cradle.<sup>16</sup>

Younger cheerleaders (5- to 11-year-olds) are 1.6 times more likely to suffer a fracture or dislocation compared with older cheerleaders (12- to 18-year-olds), and older cheerleaders are 1.2 times more likely to suffer

**TABLE 1** Overall Injury Rates in Girls' High School Sports<sup>5,7,8</sup>

| Sport        | Overall Injury Rate (per 1000 Exposures) | Catastrophic Injury Rate (per 100 000 Exposures) |
|--------------|--|--|
| Cheerleading | 0.9                                      | 0.50–1.62 <sup>a</sup>                           |
| Gymnastics   | 8.5                                      | 0.44   |
| Soccer       | 5.3                                      | 0.03   |
| Basketball   | 4.4                                      | 0.03   |
| Field hockey | 3.7                                      | 0.00   |
| Softball     | 3.5                                      | 0.02   |
| Volleyball   | 1.7                                      | 0.00   |

<sup>a</sup> Injury rate is 1.62 when based on 123 644 actual exposures reported by the NFHS for competitive cheer squads. Injury rate is 0.50 when based on 400 000 exposures estimated by the NFHS for all types of cheer teams (competitive and noncompetitive).

a sprain or strain than are younger cheerleaders.<sup>9</sup>

### Head Injuries

Concussions and other closed-head injuries account for 4% to 6% of all cheerleading injuries,<sup>5,9,11</sup> and head and neck injuries account for approximately 15% of all cheerleading injuries seen in US emergency departments.<sup>6</sup> Concussion rates in cheerleading (0.06 per 1000 exposures) are relatively low compared with other girls' high school sports, such as soccer (0.36), basketball (0.16–0.21), lacrosse (0.20), softball (0.07–0.11), and field hockey (0.10).<sup>17,18</sup> However, from 1998 to 2008, concussion rates in cheerleading increased by 26% each year, a rate greater than any of the other girls' sports studied.<sup>18</sup> Concussion rates increase with age and competitive level, likely because of the increasing difficulty of stunts.<sup>5</sup>

### Catastrophic Injuries

Catastrophic injuries are classified as direct (trauma related to participating in the skills of the sport) or indirect (body system failure resulting from exertion while participating in a sport [eg, cardiac collapse or heat stroke] or a complication from a nonfatal injury). Direct catastrophic injuries include closed-head injury, skull fractures, and cervical spine injuries resulting in permanent brain injury, paralysis, or death. From 1982 to 2009, the National Center for Catastrophic Sports Injury Research recorded 76 direct catastrophic injuries in high school cheerleaders and 34 in collegiate cheerleaders.<sup>7</sup> However, because of the much larger number of high school cheerleaders, the rate of catastrophic injuries was 5 times higher for collegiate versus high school cheerleaders (2.0 vs 0.4 per 100 000 participants, respectively).<sup>1</sup> Although the overall risk of injury is lower in

cheerleading than in most other sports, the risk of direct catastrophic injury is considerably higher for cheerleading. From 1982 to 2009, cheerleading accounted for 65.0% of all direct catastrophic injuries to girl athletes at the high school level and 70.8% at the college level.<sup>7</sup>

### RISK FACTORS FOR INJURY

Risk factors for cheerleading injuries include higher BMI,<sup>11</sup> previous injury,<sup>11</sup> cheering on harder surfaces,<sup>19</sup> performing stunts, and supervision by a coach with low level of training and experience.<sup>11</sup> Critical height is defined as the approximate fall height below which a life-threatening injury would not be expected to occur. Critical height is much higher for a landing mat on a foam floor (11 ft) and for a spring floor (10.5 ft) than for concrete or vinyl tile floor (0.5 ft).<sup>19</sup> Critical heights for natural grass, artificial turf, and wood gym floor are 3.5 ft, 4 ft, and 4.5 ft, respectively (Fig 1). The most serious cheerleading injuries occur at or above the critical height for the surface on which the cheerleader is performing at the time of

injury.<sup>20</sup> Some data<sup>11</sup> indicate that bases and flyers are at similar risk for injury during stunts, but others suggest that bases are at higher risk.<sup>10</sup>

### INJURY PREVENTION

To increase safety, the American Association of Cheerleading Coaches and Advisors (AACCA)<sup>21</sup> and the NFHS<sup>22</sup> have enacted rules and recommendations, including requiring coach training and certification, proper strength and conditioning for all cheerleaders, avoiding stunts and tumbling on hard surfaces, and specific rules for execution of technical skills. Examples include the following: (1) pyramid height limited to no more than 2 persons; (2) top cheerleader must be supported by 1 or more bases in direct weight-bearing contact with performing surface; (3) bases must be stationary and maintain constant contact with suspended cheerleaders; (4) basket toss should be limited to 4 throwers, the toss should start from ground level, and 1 thrower must be behind the flyer during the toss; (5) spotters must be present for every

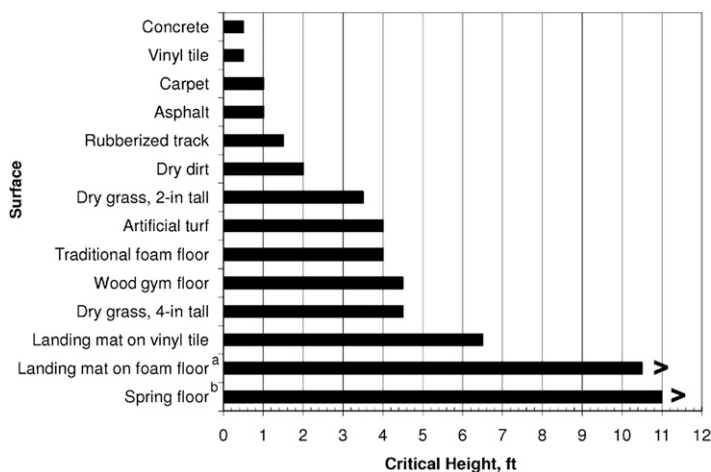


FIGURE 1

Critical height for cheerleading surfaces. <sup>a</sup>Landing mat on traditional foam floor. Limits of Triax 2000 were reached before critical height was attained. <sup>b</sup>Limits of Triax 2000 were reached before critical height was attained. Reprinted with permission from Shields BJ, Smith GA. The potential for brain injury on selected surfaces used by cheerleaders. *J Athl Train.* 2009;44(6):573.

person extended above shoulder level; and (6) suspended persons are not to be inverted or rotated on dismount.

Although spotters are commonly used during more difficult skills, active spotting of a maneuver does not significantly decrease the number of serious injuries sustained.<sup>20</sup> This could be because spotters may not have had appropriate training or lack sufficient core and upper body strength and balance to spot effectively.

One study revealed cheerleaders supervised by coaches with the most education, qualifications, and training had a nearly 50% reduction in injury risk compared with cheerleaders supervised by coaches with the lowest amount of education, qualifications, and training.<sup>11</sup> However, another study revealed that injury rates were not associated with the number of cheerleading safety training or certification programs completed by the coach or years of coaching experience.<sup>5</sup> Still, most agree that requiring coaches to obtain certification in a standardized training program that focuses on safe practices is a logical step in decreasing risk of injury among cheerleaders.

## RECOMMENDATIONS

The American Academy of Pediatrics recommends that its chapters and individual pediatricians, especially those serving as school physicians, advisors, or consultants, work with their interscholastic athletic associations and other state and local cheerleading regulating bodies to ensure that the following guidelines are followed to reduce cheerleading injuries.

1. Cheerleading should be designated a sport so that it is subject to rules and regulations set forth by sports governing bodies (eg, NCAA, NFHS) and school athletic departments. Designation of cheerleading as a sport will afford it the same benefits as other sports, such as availability of athletic trainers, improved access to medical care, limits on practice time, better facilities, certified/qualified coaches, and inclusion in injury surveillance data.
2. Cheerleaders should have a pre-participation physical examination before participating in a cheerleading program and should have access to appropriate strength and conditioning programs.
3. Cheerleaders should be supervised by qualified coaches who have been trained and certified in proper spotting for gymnastics and partner stunts, safety measures, and basic injury management.
4. Cheerleaders should be trained in proper spotting techniques and should only attempt stunts after they have demonstrated appropriate skill progression and proficiency required to complete the stunt. Spotters and bases should have adequate upper body and core strength and balance to support flyers.
5. Technical skills, such as pyramids, mounts, tosses, and tumbling, should not be performed on hard (eg, concrete, asphalt), wet, or uneven surfaces or surfaces with obstructions. No cheer events should take place on dirt, vinyl floors, concrete, or asphalt.
6. Pyramids and partner stunts should only be performed on a spring floor or with a landing mat on either a traditional foam floor or grass/turf.
7. Pyramids should not be more than 2 people high and should only be performed with spotters.
8. Coaches should follow rules for execution of technical skills set forth in the most recent version of the NFHS *Spirit Rules Handbook* (<http://www.nfhs.com/c-229-spirit.aspx>) and the AACCA *Cheerleading Safety Manual* (<http://aacca.org/content.aspx?item=Safety/2011-12SchoolCheerleadingRules.xml>).
9. Coaches, parents, and athletes should have access to a written emergency plan, designed by school administrators in conjunction with the team physician and/or certified athletic trainer. Whenever possible, a certified athletic trainer or physician should be present at practices and competitions.
10. Cheer competitions should be held in venues that are compliant with guidelines of the National Cheer Safety Foundation and the AACCA.
11. Any cheerleader showing signs of a head injury should be removed from practice or competition and not allowed to return until he or she has received written clearance from a physician or qualified health care provider. Coaches, parents, and officials should be knowledgeable regarding the cause, prevention, recognition, and response to concussion. Free online educational materials are available through the Centers for Disease Control and Prevention (<http://www.cdc.gov/concussion/>) and the NFHS (<http://www.nfhs.org>).
12. Surveillance of cheerleading injuries should continue. All catastrophic injuries should be reported to the National Center for Catastrophic Sports Injury Research at [Mueller@e-mail.unc.edu](mailto:Mueller@e-mail.unc.edu) or National Cheer Safety Foundation at <http://nationalcheersafety.com> or by calling their Injury Reporting Hotline at 1-800-596-7860 ext 201. Research regarding injury epidemiology, mechanisms, and effectiveness of safety measures is necessary to guide new rules



and recommendations for improving safety.

## APPENDIX: CHEERLEADING TERMINOLOGY

### Tumbling

Any gymnastic or acrobatic skill executed on the performing surface. Examples include the following:

#### Round-off

A skill similar to a cartwheel but with both feet landing at the same time. It is almost always the beginning skill for all back tumbling passes.

#### Handspring/Flip-Flop

A front or back tumbling skill that takes off from the feet onto the hands and back onto the feet. It is commonly a set-up for a front or back tuck (flip).

#### Somersault/Salto/Flip/Somie

An acrobatic movement where the body makes a complete aerial turn (360 degrees) in the transverse axis. Can be performed forward, backward, or sideways.

### Base

Person with at least 1 foot on the floor who is in direct, weight-bearing contact with the performing surface and who provides primary support for another person (flyer).

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### Flyer

Person who is elevated and/or tossed in the air by a base and may perform twists and/or flips before being caught by 1 or more bases.

### Spotter

Person who remains in contact with the performing surface, is responsible for watching for hazards, and must be prepared to catch the flyer if he or she falls.

### Stunts

Maneuvers in which 1 or more bases supports 1 or more flyers off the ground, such as the following:

#### Basket Toss

A stunt in which a flyer is tossed by bases whose hands are interlocked.

#### Cradle

A dismount from a stunt in which the flyer is caught in a face-up, piked position in the arms of 1 or more bases.

#### Pyramid

A stunt in which 2 or more bases support 1 or more flyers off the ground.

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