



CHEERLEADING INJURIES

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Cheerleading originated in 1898, when a young man led cheers at a collegiate football game in Minnesota.¹⁻⁴ Cheerleading continues to grow in both popularity as well as technical complexity and is now considered a contact sport. This rapidly growing sport combines elite level gymnastic tumbling, dance, as well as complex high-flying stunts. The cheerleading team includes several groups, including “flyers” who are lifted or tossed into the air by their “bases” while “spotters” stand close by to prevent falls.⁴ Participation ranges from sideline support of another sporting event (performance) to year-round “all star” or competitive cheerleading. This combination of activities with increasing complexity of the routines and stunts puts these athletes at high risk for injury.

Epidemiology of Injuries

As of 2012, only 29 state high school athletic associations recognized cheerleading as a sport and the National Collegiate Athletic Association (NCAA) did not include competitive cheerleading as a sponsored sport.² As a result, the injuries that occur in cheerleading are often not reported in sports injury surveillance systems of state high school athletic associations or the NCAA. So, up until some more recently published epidemiology studies, there has been a relative lack of data on injuries.

With the increasing popularity of this sport, the injury rate also continues to rise with an annual cheerleading related injury rate increase of 189% being shown from 2001 to 2012.^{2,3,5}

The overall injury rate is relatively low compared to other sports, but the injuries tend to be more severe.⁸⁻¹¹ Data collected by the longitudinal, National High School Sports-Related Injury Surveillance Study from 2009–2010 through 2013–2014 ranked cheerleading 18th out of 22 sports in terms of overall injury rate.⁹ Despite the low injury rate, this study revealed that cheerleading had the second highest proportion of injuries resulting in time lost of at least 3 weeks. Also, cheerleading has been shown to have a disproportionately high rate of catastrophic injuries (over 50% of all catastrophic injuries in high school girl athletes), including skull fractures, death, cervical fractures or major ligamentous injury, spinal cord contusions, paralysis, and severe head injuries resulting in permanent brain injury, compared to other sports.^{2,8-12}

Injury rates are higher in the older age groups due to the increased complexity of the routines and more height-based stunts.^{1,10,13,14} College cheerleaders have the highest injury rate (1.2 to 2.4 injuries per 1000 athlete exposure), followed by elementary school, high school, all-star, middle school, and recreational cheerleaders.¹⁴⁻¹⁶ In a retrospective analysis

of the NEISS emergency department database, Shields and Smith¹³ reported that there were more emergency room visits for cheerleaders in the 12–17 year old age group than in the 6–11 year old age group. More catastrophic injuries also occur in the older age groups. Boden et al.¹⁰ noted that the rate of catastrophic injury per 100,000 cheerleaders was five times higher at the collegiate level than high school level.

Mechanism of Injury

The leading mechanism of injury is falls (29.4%), with falls being most likely to lead to hospitalization than other mechanisms.³ Overall, stunting causes 42–60% of cheerleading injuries and 96% of concussions and closed-head injuries.^{6,18,19} More specifically, pyramid stunts where there is potential for a contact injury between cheerleaders accounts for the majority of head/neck injuries (50–66%)^{7,8,15,17} Jacobson et al.⁵ reviewed the National Electronic Injury Surveillance System from 2002 to 2007 and found the most common mechanisms of injury to be collision 29.3%, stunting 19.8%, tumbling 11.3%, and tossing 2.5%. Naiyer et al.³ examined injury rates over a 23-year period also using a national electronic database and found significant increases as well. Boden et al.¹⁰ reported that the most common stunts being performed when a catastrophic injury occurred were a pyramid and basket toss. Less cushioned and wet surfaces and increased fall heights (11 feet) have also been noted to predispose to catastrophic injury.^{10,14}

Another common mechanism of injury is basing or spotting. Two studies by Shields and Smith^{1,14} reported that the basing or spotting was the most common mechanism of injury. Currie et al.⁹ noted that the most common cheerleaders injured were the bases. Interestingly, the bases at the bottom of the pyramids can be at greater risk than the ones held aloft or tossed in the air.⁵ These studies indicate

that bases are at particular risk of injury from contact with other athletes during stunts. Also, basing or spotting is more likely to result in lower back sprain/strains than any other mechanism.¹

Finally, tumbling accounts for 14–26% of cheerleading injuries.^{14,17} Shields and Smith¹⁴ noted that tumbling was the most common mechanism of injury for strictly competitive All-Star teams. Tumbling is also the common mechanism for sprain/strains.

Injuries

Sprains/strains are, by far, the most common types of injuries sustained in cheerleading, involving up to 53% of all injuries, followed by abrasions/contusions/hematomas (13–18%), fractures/dislocations (10–16%), lacerations/punctures (4%), and concussion/head injuries (3.5–4%).^{2,3,13,14} Common injury patterns range from ligament and muscle sprains/strains to fractures. Injuries to the cervical spine, lumbar spine, and head are less common, but can be more serious type of injury.

Overall in all age groups, sprains/strains occur more often in the lower extremities than upper extremities.^{3,13,14} However, when viewing specific age groups, Shields and Smith¹³ found that younger cheerleaders (6- to 11-year age group) are more likely to sustain upper extremity injuries and less likely to sustain lower extremity injuries than older cheerleaders (12- to 17-year age group). Similarly, Naiyer et al.³ noted that upper extremity injuries (42.7% of injuries) were more common in younger athletes. The most commonly injured joints are ankles (44.9% of all injuries) followed by wrists/hands (19.3%).^{1,6} Most injuries to the ankle involve the lateral ligaments and result from injuries with the ankle in a plantar-flexed position.¹

Fractures or dislocations are 1.6 times more likely to occur in younger cheerleaders (5 to 11 year olds) than older cheerleaders (12 to 18 year olds) while older cheerleaders are more likely

to sustain a strain or sprain than younger cheerleaders.¹³ Jacobson et al.⁵ reported that 61.5% of all cheerleading related fractures presenting to emergency departments involve the upper extremity and that injuries to the upper extremity account for 58.5% of hospital admissions. This study also noted that 93.5% of the upper extremity fractures were treated and discharged from emergency departments, indicating that most of these injuries were stable with a low risk of complication.⁵ Those cheerleaders who were admitted more commonly sustained supracondylar humerus fractures or both bone forearm fractures, which are injuries with a higher risk of complication and which more commonly require surgical intervention.⁵

As discussed above, cheerleading produces a disproportionate share of direct catastrophic injuries. The National Center for Catastrophic Sports Injury (NCCSIR) reported that cheerleading accounted for 65% of direct catastrophic injuries to all high school female sports participants and 70.8% of catastrophic injuries to female college athletes over a 17-year period.¹¹

Cervical Spine

There are multiple activities performed during cheerleading that could result in cervical spine injuries, including tumbling, stunting, baskets, and pyramid. At times, these athletes can be between 6 and 20 feet in the air either being thrown, tumbling, or held up. All of which, are at risk, if done incorrectly, of landing in such a way to result in cervical spine fracture/ligamentous injury, as well as spinal cord injury.

Additionally, Boden et al.¹⁰ found that there was a high association with concomitant head injury. This study reported 28% incidence of cervical fracture or ligament injury and 10% incidence of spinal cord contusion. The spinal cord injuries resulted in both complete and incomplete injuries at C2, C3, C5, and C6 causing partial or complete quadriplegia with significant



devastating health and emotional impact. All of these injuries were a result of the cheerleader making contact with a hard surface such as the ground. They also reported that the rate of catastrophic injuries to collegiate cheerleaders was five times higher than the injury to high school cheerleaders and a majority of the injuries occurred in the winter months.¹⁰

Head Injuries

As with other contact sports, cheerleaders are at significant risk for concussion. Similar to cervical spine injury risk, these injuries most commonly are a result of a fall from height. Several studies indicate that the aerial stunts put these athletes at a not insignificant risk for concussion.^{2-6,9,17,18} Risk of cheerleading related concussion has increased >200% over the past 10 years.³

Concussion rates in cheerleading have been reported to be relatively low (4–6% of cheerleading injuries) in the past compared to other injuries and compared to concussion rates in other sports.^{13,14,17,20,21} However, in a recent study, Currie et al.⁹ found that concussions were the most common cheerleading

injury, accounting for 31.1% of injuries. Similarly, Naiyer et al.³ reported that the number and rate of cheerleading related concussions/closed head injuries increased significantly by 290% from 2001 to 2012. This may be a reflection of the increasing complexity of cheerleading stunts and routines over the years. It also could be secondary to the increased awareness of and heightened attention to concussions as the concussion rate has increased in other sports as well over a similar time period.^{3,22} Although the overall concussion rates in cheerleading are significantly lower than in other female sports combined, there is a much higher rate of concussions in practice compared to other sports, which could be a function of the athlete trying newer, more dangerous stunts or a team trying newer, more complex routines during practice.⁹

Risk Factors for Injury/Injury Prevention

The growing increase in complexity has led to the development of safety organizations to protect these athletes. The American Association of Cheerleading Coaches and Administrators (AACCA), the United States All Star Federation (USASF),

CheerSafe, and the National Federation of State High School Associations (NFHS) are governing bodies that were established to set rules for cheerleading safety to limit risk and help protect athletes at all levels of participation. The American Academy of Pediatrics (AAP) has also made additional safety recommendations.

First, cheerleading should be designated as a sport, so that it is subject to the rules and regulations set forth by sport governing bodies including the NCAA and NFHS.² This will improve access to athletic trainers, appropriate medical care, certified/qualified coaches, better facilities, and an injury surveillance program.² This would also necessitate that the cheerleaders have a pre-participation physical examination and access to appropriate strength and conditioning programs.² Also, cheerleaders should only attempt stunts after they have demonstrated appropriate skill progression and proficiency required by the stunt.² Next coaches, parents, and athletes should have access to an emergency plan for serious injuries, which is formulated by school administrators in conjunction with an athletic trainer and team physician.² If a cheerleader demonstrates signs of a head injury, he or she should be removed from practice or competition and not allowed to participate until there is written clearance from a qualified health care provider.² Finally, cheer competitions should take place in venues, which are compliant with guidelines set forth by the National Cheer Safety Foundation and the AACCA and where there is appropriate medical coverage.²

Several risk factors for cheerleading injuries have been identified. Elevated

BMI, deconditioned athletes, and previous injury have all been associated with increased risk of injury.^{1,3,17} Sprains and strains, in particular ankle sprains, are the most common injuries, so conditioning and training exercises emphasizing balance and coordination and resistance strengthening would be an effective preventive strategy.^{1,3} Also, spotters are at particular risk for low back strains/sprains as they support and catch flyers, so upper body and core strength exercises can be of benefit in this group. Finally, since the greatest risk for sprain/strain is a history of past injury, this could indicate that previous injuries are often underestimated in terms of severity and inadequately rehabilitated with a premature return to training or competition.^{2,3} Therefore, it is important to fully rehabilitate injuries with balance and strengthening exercises before returning to help prevent re-injury.

Care must be taken to assure athletes and coaches have been well trained for the level of difficulty they are attempting to perform. Inadequate supervision either by the absence of a coach or the presence of a coach with low level training and experience has been shown to predispose cheerleaders to injury.¹⁷ Schulz et al.¹⁷ reported that cheerleaders supervised by coaches with the most education, qualifications, and training had a nearly 50% reduction in injury compared to those supervised by coaches with less training. Knowledgeable coaches are paramount to ensure that appropriate techniques are being taught, appropriate strengthening and conditioning is being performed, injuries are being recognized

and treated, and the cheerleading rules and recommendations set forth by national organizations such as the AACCA, CheerSafe, (NFHS), USASF, and AAP are being followed.^{1-3,10} Since falls and spotting are the most common mechanisms of injury, coaches need to especially make sure that proper spotting techniques are being taught and emphasized. The AAP in its cheerleading policy statement recommends that cheerleaders should be supervised by quality qualified coaches who have been trained and certified in proper spotting for gymnastics and partner stunts, safety measures, and basic injury management.

The AAP policy statement also recommends that technical skills such as pyramids, mounts, tosses, and tumbling should not be performed on hard, wet, or uneven surfaces and that pyramids and partner shoulder stunts should only be performed on a spring floor or a landing mat on either a traditional foam floor or grass/turf.²

Pyramids and basket tosses at increased heights both carry a high risk for potential catastrophic injury.¹⁰ Therefore, the NFHS and AACCA made several important rule changes to make the pyramid stunt safer.²⁴ Height restrictions are limited to 2 levels in high school and 2.5 body lengths in college.²⁴ Additionally, it is important that these activities are on safe proper performing surfaces/floor mats, spring floor, which are specifically designed for these activities. Further rules have been mandated for the basket toss, which has been shown to carry the highest risk of injury. Current AACCA rules

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include that the stunt is limited to four throwers with one of the throwers behind the top person during the toss, as well as the toss must start from the ground. The flyer must also be trained to not allow the head to drop backward out of alignment with their torso or below the horizontal plane of the body. These guidelines further protect the athletes.

Conclusions

Cheerleading is a rapidly growing sport on a national and international level, and cheerleading stunts and routines have become much more complex over the past two decades. As a result, both the number

and severity of injuries have increased. As a response to this, numerous cheerleading associations at every level of competition and participation, have developed improved surveillance systems to track these injuries as well as rules/regulations to improve safety. It is important for sports medicine physicians treating cheerleaders to familiarize themselves with these rules and to help educate coaches, families, and participants on the importance of following these guidelines. Finally, it is important for sports medicine physicians and sports medicine organizations to continue to monitor cheerleader injuries and refine the rules and regulations to improve safety.



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