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Cheerleading-Related Injuries to Children 5 to 18 Years of Age: United States, 1990–2002

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ABSTRACT

OBJECTIVE. To describe the epidemiology of cheerleading-related injuries among children in the United States.

DESIGN. A retrospective analysis of data for children 5 to 18 years old from the National Electronic Injury Surveillance System (NEISS) of the US Consumer Product Safety Commission, 1990–2002.

METHODS. Sample weights provided by the NEISS were used to make national estimates of cheerleading-related injuries. Injury rates were calculated for the most frequently occurring types of injury using cheerleading participation data.

RESULTS. An estimated 208 800 children (95% confidence interval [CI]: 166 620–250 980) 5 to 18 years of age were treated in US hospital emergency departments for cheerleading-related injuries during the 13-year period of 1990–2002. The number of injuries increased by 110% from 10 900 in 1990 to 22 900 in 2002, with an average of 16 100 (95% CI: 12 848–19 352) injuries per year ($P < .01$). The average age of injured children was 14.4 years (median: 15.0 years); 97% were female; and 85% of injuries occurred to children 12 to 17 years old. The number of injuries per 1000 participants per year was greater for 12- to 17-year-olds (8.1) than for 6- to 11-year-olds (1.2) for all cheerleading-related injuries combined ($P < .01$; relative risk [RR]: 6.49; 95% CI: 6.40–6.58), as well as for injuries grouped by body part injured and type of injury. The body parts injured were lower extremity (37.2%), upper extremity (26.4%), head/neck (18.8%), trunk (16.8%), and other (0.8%). Injury diagnoses were strains/sprains (52.4%), soft tissue injuries (18.4%), fractures/dislocations (16.4%), lacerations/avulsions (3.8%), concussions/closed head injuries (3.5%), and other (5.5%). Children in the 12- to 18-year age group were more likely to sustain strains or sprains to the lower extremity than 5- to 11-year-olds ($P < .01$; RR: 1.62; 95% CI: 1.50–1.88). The majority of patients with cheerleading-related injuries was treated and released from the emergency department (98.7%). Patients sustaining fractures or dislocations were more likely to be admitted to the hospital than those sustaining other types of injury ($P < .01$; RR: 5.30; 95% CI: 3.29–6.43).

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Abbreviations

AACCA—American Association of

Cheerleading Coaches and Advisors

ED—emergency department

NEISS—National Electronic Injury

Surveillance System

CPSC—Consumer Product Safety

Commission

RR—relative risk

CI—confidence interval

UNL—University of Nebraska-Lincoln

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CONCLUSIONS. To our knowledge, this study is the first to report numbers, rates, and trends of cheerleading-related injuries to children using a nationally representative sample. Cheerleading is an important source of injury to girls. The number of cheerleading-related injuries more than doubled during the 13-year study period. A set of uniform rules and regulations directed at increasing the safety of cheerleading, that are universally enforced, should be implemented. Mandatory completion of a safety training and certification program should be required of all cheerleading coaches. Establishment of a national database for cheerleading-related injuries would facilitate the development and evaluation of injury-prevention strategies based on epidemiologic evidence.

CHEERLEADING ORIGINATED ON November 2, 1898, when Johnny Campbell led the first cheers at a Minnesota University football game.^{1,2} The primary purpose of cheerleading is raising school unity through leading the crowd in cheers at athletic functions.¹ Since 1980, cheerleading has evolved into an activity demanding high levels of skill and athleticism.^{2,3} Some states consider cheerleading a school activity, and others consider it a sport.³ It is the position of the American Association of Cheerleading Coaches and Advisors (AACCA) that cheerleading is an “athletic activity” that shares a special balance between school-spirit functions and athletic competitions.¹ In 2002, there were an estimated 3.5 million cheerleading participants who were ≥ 6 years of age, representing an estimated 18% increase in the number of participants since 1990.⁴

Increases in the number of cheerleading-related injuries have occurred in response to the change from previous cheerleading styles to more gymnastic-type cheerleader skills.^{5,6} Cheerleading differs from many other sports because it is a year-round activity.⁷ Cheerleaders are asked to perform through 3 seasons, peak for national competitions, and attend cheerleading-training camps in the summer.^{1,7} Although other sports involve a greater risk of injury compared with cheerleading, cheerleading-related injuries tend to result in greater amounts of time lost because, unlike other sports, cheerleading requires the use of all the extremities and a cheerleader cannot simply tape up a sprain or participate while in a wrist cast.⁷

The majority of cheerleading-related injuries reported in the literature is included with accounts of sports-related injuries in general^{5,8–11} or are in the form of case reports.^{7,12–15} Few epidemiologic studies of cheerleading-related injuries exist in the literature. This report describes the epidemiology of cheerleading-related injuries requiring emergency-department (ED) treatment among children 5 to 18 years of age in the United States from 1990 through 2002 using data from the National

Electronic Injury Surveillance System (NEISS) of the US Consumer Product Safety Commission (CPSC).

METHODS

Data Source

The CPSC monitors injuries treated in US hospital EDs through the NEISS. The NEISS was established in 1972 and has had revisions made in its sampling frame in 1978, 1990, and 1997. The NEISS obtains data from a probability sample of 98 hospitals, which were selected from the population of all hospitals with EDs with at least 6 beds in the United States and its territories.¹⁶ Projections of injuries occurring nationally are made from this probability sample. Data regarding injuries associated with consumer products and recreational activities are collected on a daily basis via computer from each participating hospital. The NEISS has been shown to be highly sensitive and accurate in identifying consumer product-related injury cases.^{17–20}

Data were obtained from the CPSC regarding cheerleading-related injuries (product code 3254) reported through the NEISS during the 13-year period (1990–2002). The narrative for each case was reviewed, and cases mentioning “drill team,” “color guard,” “flag corp,” “flag line,” or a final diagnosis of “dermatitis” or “conjunctivitis” were excluded from this study. Cases in which the patient was listed as a cheerleading coach or spotter and those occurring at cheerleading practice but were not cheerleading-related were also excluded.

Data Analysis

The types of injury were grouped into 6 categories during the study analyses: (1) fracture/dislocation; (2) laceration/avulsion; (3) soft tissue injury (abrasion, contusion, and hematoma); (4) concussion/closed head injury; (5) strain/sprain; and (6) other (foreign body, crushing injury, nerve damage, hemorrhage, dental injury, and anoxia). Likewise, the body parts injured were grouped into 5 categories during study analyses: (1) upper extremity; (2) lower extremity; (3) head/neck; (4) trunk; and (5) other (internal, pubic region, and $\geq 25\%$ of body). For the purposes of this study, we defined “serious” injuries as concussions/closed head injuries, skull fractures, and vertebral fractures. We divided the patients into 2 age groups for analyses: 5–11 and 12–18 years. These categories were chosen because they separate elementary school-aged children from middle and high school-aged children. Although smaller age-group subdivisions exist for national competitions,^{21,22} there were not enough younger patients in the present study to create additional subgroups.

The data were analyzed by using SPSS software.²³ Sample weights provided by the NEISS were used in all analyses to adjust for the inverse probability of selection and make national projections regarding cheerleading-

related injuries. Unweighted numbers <20 were not used for data analyses, because they would provide unstable estimates. Statistical analyses included linear regression and χ^2 analysis with Yates' correction. Computation of relative risks (RRs) with 95% confidence intervals (CIs) was also performed. The level of significance for all statistical tests was $\alpha = .05$. All data reported are national estimates unless identified as unweighted sample data.

Injury-Rate Calculations

Cheerleading-participation data were obtained from "The Superstudy of Sports Participation."⁴ These data are based on self-reports for individuals in the United States who are ≥ 6 years old and participated in cheerleading at least once during a 12-month period. Participation data for children 6 to 11 and 12 to 17 years of age were available for 2003 only. The number of injuries per 100 participants per year was calculated for the most frequently occurring types of injury and body parts injured. All reported injury rates are based on 2003 participation data.

Ethical Considerations

This study was approved by the institutional review board of the Columbus Children's Research Institute.

RESULTS

Sample Description

During the 13-year period (1990–2002), 5396 cheerleading-related injuries were reported to the NEISS. These injuries represent an estimated 223 300 cheerleading-related injuries nationally. An estimated 208 800 children (95% CI: 166 620–250 980) 5 to 18 years of age were treated in US hospital EDs for cheerleading-related injuries during the 13-year period (1990–2002). These injuries represent 93% of all cheerleading-related injuries reported to the NEISS during this time period. The average age of injured children was 14.4 years (median: 15.0 years); 97% were female; and 85% of these injuries occurred to children who were 12 to 17 years old (Fig 1).

The number of injuries increased by 110% from 10 900 in 1990 to 22 900 in 2002, with an average of 16 100 (95% CI: 12 848–19 352) injuries per year ($P < .01$) (Fig 2). Cheerleading-related injuries occurred throughout the year, with peak periods from September to November and December to February, representing 44% and 26%, respectively, of all cheerleading-related injuries to children 5 to 18 years of age during the study period (Fig 3). These peaks are associated with football and basketball seasons, respectively.

The majority of cheerleading-related injuries occurred at school (61.9% [99 605 of 161 012]) or a place

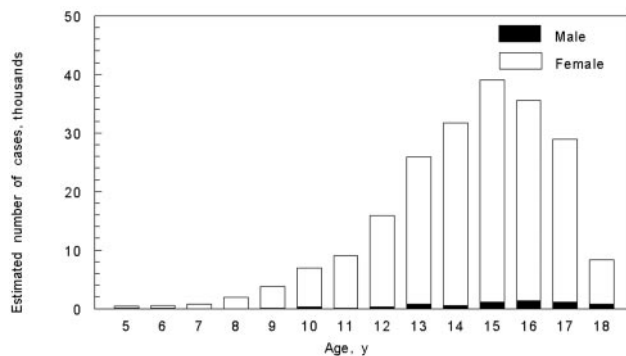


FIGURE 1
Estimated number of children 5 to 18 years of age with cheerleading-related injuries according to age and gender: US EDs, 1990–2002.

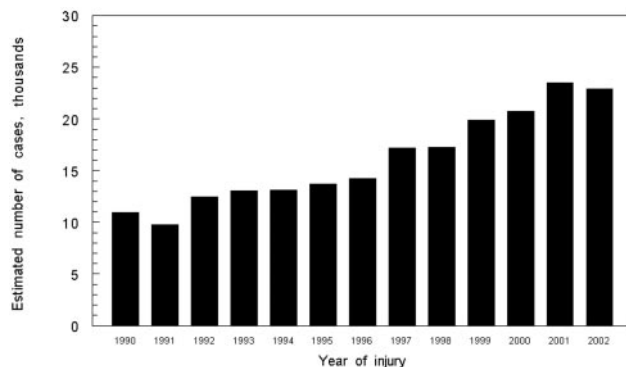


FIGURE 2
Estimated number of children 5 to 18 years of age with cheerleading-related injuries according to year of injury: US EDs, 1990–2002.

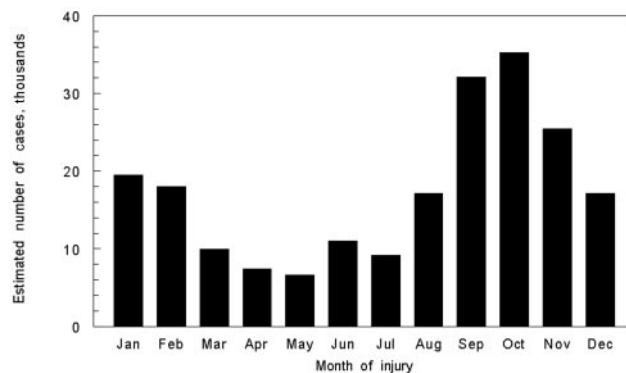


FIGURE 3
Estimated number of children 5 to 18 years of age with cheerleading-related injuries according to month of injury: US EDs, 1990–2002.

of recreation or sports (30.7% [49 413 of 161 012]). The remainder of the injuries occurred at home (5.1% [8202 of 161 012]) or on other public property (2.4% [3793 of 161 012]). The location of the injury event was not documented for 47 740 of the 208 752 cases (22.9%). There was no relationship between age of the participant and location of the injury event.

Body Part Injured

The body parts injured were the lower extremity (37.2%), upper extremity (26.4%), head/neck (18.8%), trunk (16.8%), and other (0.8%). Upper-extremity injuries were more common among the 5- to 11-year-olds compared with 12- to 18-year-olds ($P < .01$; RR: 1.66; 95% CI: 1.56–1.77), whereas lower-extremity injuries were more common in the 12- to 18-year-olds compared with the 5- to 11-year-olds ($P < .01$; RR: 1.33; 95% CI: 1.16–1.52).

Type of Injury

Injury diagnoses were strains/sprains (52.4%), soft tissue injuries (18.4%), fractures/dislocations (16.4%), lacerations/avulsions (3.8%), concussions/closed head injuries (3.5%), and other (5.5%). Fractures or dislocations were more common in the 5- to 11-year age group compared with 12- to 18-year-olds ($P < .01$; RR: 1.61; 95% CI: 1.36–1.90). Strains or sprains were sustained more often by 12- to 18-year-olds than by 5- to 11-year-olds ($P < .01$; RR: 1.21; 95% CI: 1.09–1.36).

Most Common Injuries (Body Part and Injury Type Combined)

Children in the 12- to 18-year age group were more likely to sustain strains or sprains to the lower extremity than those in the 5- to 11-year age group ($P < .01$; RR: 1.62; 95% CI: 1.50–1.88). The incidence of serious cheerleading-related injuries reported to the NEISS during the period 1990–2002 was low. Of these injuries there were an estimated 4153 closed head injuries (2.00%; 154 unweighted), 3170 concussions (1.52%; 77 unweighted), 545 fractures to the lower trunk (0.26%; 14 unweighted), 250 fractures to the upper trunk (0.12%; 8 unweighted), 89 cervical fractures (0.04%; 3 unweighted), and 33 skull fractures (0.02%; 3 unweighted).

Hospital Admissions

The majority (98.7% [205 878 of 208 645]) of patients with cheerleading-related injuries was treated and released from the ED. Patients who sustained fractures or dislocations were more likely to be admitted to the hospital than those sustaining other types of injuries ($P < .01$; RR: 5.30; 95% CI 3.29–6.43). Of these 1410 patients, 829 (58.8%; 22 unweighted) sustained upper extremity fractures/dislocations, and 467 (33.1%; 12

unweighted) sustained lower-extremity fractures/dislocations.

Injury Rates

Children in the 12- to 17-year age group sustained 84.8% (177 105 of 208 752) of the injuries reported in this study population, whereas children in the 6- to 11-year age group sustained 11.0% (22 929 of 208 752) of the injuries. The number of injuries per 1000 participants per year was greater for 12- to 17-year-olds (8.1) than for 6- to 11-year-olds (1.2) for all injuries combined ($P < .01$; RR: 6.49; 95% CI: 6.40–6.58) and for injuries grouped by body part injured and type of injury. The estimated number and rate of cheerleading-related injuries for all injuries combined and for the 3 most commonly injured body parts and types of injury, according to age group, are presented in Tables 1 and 2. The average number of injuries per year and the rate of injury for all injuries combined are reported by stratifying according to body part injured, type of injury, and age group.

DISCUSSION

To our knowledge, this study is the first to report national estimates, rates, and trends of cheerleading-related injuries to children. We found a 110% increase in the estimated number of cheerleading-related injuries to children 5 to 18 years of age who were treated in US hospital EDs during the 13-year period (1990–2002). This trend was paralleled by an estimated 18% increase in the number of cheerleading participants who were ≥ 6 years of age during the same time frame.⁴ The greater increase in the number of cheerleading-related injuries compared with the increase in the number of cheerleading participants may be attributed partly to the increased difficulty of cheerleading skills being attempted in recent years.^{5,6} In addition, the greater number of injuries per 1000 participants sustained by 12- to 17-year-olds compared with 6- to 11-year-olds may reflect a greater level of difficulty of maneuvers being attempted by older participants.

Our findings are consistent with those reported by others.^{7,24,25} Strains and sprains were the most common type of injury sustained, and injuries to the lower extremity were more common, followed by injuries to the upper extremity and injuries to the head and neck.

TABLE 1 Estimated Number and Rate of Cheerleading-Related Injuries Treated in US Hospital EDs From 1990 Through 2002 According to Age Group

	Age Group		
	5–18 y	6–11 y	12–17 y
Total, <i>n</i> (%)	208 752 (100.0)	22 929 (11.0)	177 105 (84.8)
Average number per year	16 058	1764	13 623
Number per 1000 participants per year	NA	1.2	8.1

NA indicates not applicable.

TABLE 2 Estimated Number and Rate of Cheerleading-Related Injuries Treated in US Hospital EDs From 1990 Through 2002 for the 3 Most Commonly Injured Body Parts and Injury Types According to Age Group

	Age Group		
	5–18 y	6–11 y	12–17 y
Body part injured ^a			
Lower extremity			
Total, <i>n</i> (%)	77 590 (37.2)	6651 (29.1)	67 949 (38.4)
Average number per year	5968	512	5227
Number per 1000 participants per year	N/A	0.4	3.1
Upper extremity			
Total, <i>n</i> (%)	54 974 (26.4)	9379 (41.0)	44 149 (25.0)
Average number per year	4229	721	3396
Number per 1000 participants per year	N/A	0.5	2.0
Head/neck			
Total, <i>n</i> (%)	39 112 (18.8)	3693 (16.2)	32 660 (18.5)
Average number per year	3009	284	2512
Number per 1000 participants per year	N/A	0.2	1.5
Type of injury ^b			
Strain/sprain			
Total, <i>n</i> (%)	108 981 (52.4)	10 241 (44.7)	94 960 (53.8)
Average number per year	8383	788	7305
Number per 1000 participants per year	N/A	0.6	4.3
Soft tissue injury			
Total, <i>n</i> (%)	38 412 (18.4)	3850 (16.8)	32 479 (18.4)
Average number per year	2955	296	2498
Number per 1000 participants per year	N/A	0.2	1.5
Fracture/dislocation			
Total, <i>n</i> (%)	34 230 (16.4)	5754 (25.1)	27 566 (15.6)
Average number per year	2633	443	2120
Number per 1000 participants per year	N/A	0.3	1.3

The percentages represent the percentage of children in each age group who sustained each category of injury.

^a The body part injured was not documented for 330 cases.

^b Type of injury was not documented for 497 cases.

The age-related injury patterns identified here are similar to those reported for pediatric fall-related injuries.^{26–29} Associated with increasing age of the child were a decrease in the frequency of upper-extremity injuries, a decrease in the frequency of fractures and dislocations, and an increase in the frequency of lower-extremity injuries. Developmental considerations such as immature coordination and strength and open growth plates of bones may partially account for the age-related injury patterns observed in our study.²⁶ The inverse relationship between head and neck injuries and age may be the result of the relatively larger head size and higher center of gravity of younger children, which causes them to topple head first.^{28,29}

Most injuries in cheerleading occur during gymnastics maneuvers and partner stunts.^{7,25} Cheerleading maneuvers such as pyramid formations and basket tosses expose cheerleaders to an increased risk of sustaining a fall-related injury. Young children and those who participate in noncontact sports often are not taught how to fall properly to minimize injury; participants in contact sports such as football and rugby are taught to fall in a manner that diffuses the impact of the fall across as much of the body surface as possible as opposed to bracing themselves with their arms. This may partially

account for the increased frequency of upper-extremity injuries found for 5- to 11-year-olds in the present study.

Cheerleading accounts for a disproportionate share of sports-related catastrophic injury. The National Center for Catastrophic Sports Injury Research reported that cheerleading accounted for >50% of catastrophic injuries to female sports participants over a 17-year period.³⁰ Mueller and Cantu⁵ also reported that high school cheerleading accounted for 47% of all high school direct catastrophic injuries to female athletes. Although cheerleading-related injuries represent a large proportion of catastrophic injuries, the absolute number is relatively low. A maximum of 3 catastrophic injuries have been documented among high school cheerleaders in a single academic year.¹⁰ Catastrophic injuries represent the extreme of the injury spectrum. Our study reports, for the first time, the rate of cheerleading-related injuries over a broader portion of the injury spectrum using a nationally representative sample. Based on national estimates of the number of injuries reported to the NEISS in 2003 and the number of participants reported by American Sports Data, Inc⁴ for 2003, the annual injury rate per 1000 6- to 17-year-old participants for cheerleading (7.5) was lower than that reported for several other

popular sports: football (29.3), basketball (20.3), and baseball (15.7).

On March 11, 2002, the University of Nebraska-Lincoln (UNL) athletic department issued a press release stating that cheerleading stunts and tumbling would be banned in an effort to protect their student athletes from unnecessary injury.³¹ UNL stated that this decision was based on the facts that cheerleading was responsible for 57% of the catastrophic injuries to female college and high school athletes, and 1 UNL cheerleader had already been seriously injured.³² The injury being referenced involved a cheerleader who fractured her neck while doing a handspring at a practice in 1996, which resulted in a \$2.1 million legal settlement.³¹ In 2003, the new athletic director for UNL reversed the ruling of the previous athletic director and again allowed the cheerleading squad to resume use of stunts and tumbling in their routines.³³

It is difficult to compare injury rates and severity among different sports or among different research studies. The severity of an injury may be measured in different ways, such as the type of injury, the number of injuries, the number of days lost per injury, the number of surgeries performed, or whether a cast was applied.⁸ One study reported that when compared with other sports, cheerleading had the highest average days lost per injury,⁸ and another study concluded that having the highest number of days lost per injury indicates that many of the injuries were serious.² However, the same injury can affect different athletes in different ways, and often the sports-related severity of an injury depends on the sport.⁸ For example, a fractured forearm may have no effect on the ability of a track participant to compete in a race but may prevent a cheerleader from participating in cheerleading for many weeks. A sprained ankle, which is usually considered a relatively minor injury, may prevent a cheerleader from participating in cheerleading for numerous days, because cheerleading requires the use of all the extremities, and a cheerleader cannot simply tape up a sprain and continue to perform.⁷ The number of days lost per injury may also have different impacts on different sports depending on the length of the season for the sport in question. Cheerleading is a year-round activity compared with football, basketball, or baseball, each of which lasting only 2 or 3 months per year.

The major issues involved in the safety of cheerleaders include the experience levels of cheerleaders, coaches, and spotters; the conditioning of the cheerleaders; the types of maneuvers being performed; the type of surfacing on which cheerleaders practice and perform; the appropriate use of properly trained spotters; and the supervision present during practice sessions and performances. The AACCA is a national, nonprofit, educational organization dedicated to the promotion of cheerleading safety and the education of cheerleading coaches

through certification programs. The National Federation of State High School Associations provides reviews and updates of the rules and regulations for high school cheerleaders. Other cheerleading organizations include the National Cheerleaders Association, Universal Cheerleaders Association, International Cheerleading Foundation, and the US Cheerleaders Association. Rules and regulations proposed by the various cheerleading organizations are similar and address all of the aforementioned safety issues. However, there is a lack of uniform rules and regulations for cheerleaders, and those that do exist are not enforced universally. In 1 study, lower injury rates were found among cheerleaders who were supervised by more experienced, trained, and qualified coaches.¹⁰ Mandatory training and certification of all cheerleading coaches should be required. The AACCA currently offers a program that can provide this training and certification.

The lack of a national database for tracking and analyzing cheerleading-related injuries hinders development of evidence-based safety recommendations.²⁴ A national database for cheerleading-related injuries should be established to guide and evaluate injury-prevention efforts.

LIMITATIONS OF STUDY

This study has several limitations. The study underestimates the actual number of cheerleading-related injuries, because only those injuries that were treated in an ED are included. According to Schultz et al,¹⁰ only 28% of cheerleading-related injuries result in a visit to an ED. Many injuries are not treated in EDs but by cheerleaders themselves, by a trainer or coach, at a student health service, at a private physician's office, or at other non-ED health care facilities.³⁴

Data reported to the NEISS are limited by the detail found in the ED record. Some important information is also not known at the time of the ED visit. Consequently, the NEISS narrative often lacks details regarding the stunt being attempted at the time of injury; whether the injury occurred at practice or during a game or competition; the type of supervision present at the time of injury; qualifications of the coach; the experience level of the cheerleader; the number of spotters present and their level of experience and training; whether gymnastics equipment such as a trampoline was being used at the time of the injury; the number of days lost as a result of the injury; and the final outcome for the injured cheerleader.

Accurate numbers of cheerleading participants are difficult to obtain. Participant data provided by American Sports Data, Inc⁴ are the most comprehensive that we were able to find. These data were collected from self-report surveys, and information provided by survey participants was not verified. Selection of an appropriate denominator for injury rates can have a major impact on

final conclusions. For example, Xiang et al³⁵ found that age-specific injury-rate differences calculated by using the number of snow-skiing participants as the denominator disappeared when US census population estimates were used as the denominator. This led to their conclusion that, especially in sports- and recreation-related injury research, participation data more accurately reflect risk exposure and are more appropriate for calculating injury rates.

Concerns have been raised in the past regarding NEISS estimates for children's injuries.^{36–38} The NEISS has been criticized for underestimating children's injuries, because NEISS strata were based initially on geographic location and hospital size, not by hospital type.³⁸ In actuality, the NEISS may have overestimated children's injuries.^{39,40} In response to concerns, the NEISS sampling frame was changed in 1997 to include a separate children's hospitals stratum. Data reported in this study were adjusted to account for the sample change and to provide a valid estimation of cheerleading-related injuries.

CONCLUSIONS

The number of cheerleading-related injuries to children 5 to 18 years of age more than doubled during the study period, which exceeded the 18% increase in the number of cheerleading participants ≥ 6 years old during the same time period. This increase in the rate of cheerleading-related injuries is most likely a result of an increase in the difficulty of stunts being attempted by cheerleaders in recent years as cheerleading has evolved from a school-spirit activity into an activity demanding high levels of gymnastics skill and athleticism.

Although a number of cheerleading organizations have developed rules and regulations directed at increasing the safety of cheerleading, a set of uniform rules and regulations for cheerleaders needs to be developed and implemented, and these rules and regulations need to be enforced universally. In addition, there are currently no uniform requirements regarding safety training and certification for cheerleading coaches. Mandatory completion of a safety training and certification program, such as that offered by the AACCA, should be required of all cheerleading coaches. Establishment of a national database for cheerleading-related injuries would permit better identification and monitoring of risk factors for cheerleading-related injuries and aid in the development and evaluation of injury-prevention strategies based on epidemiologic evidence.

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OLD AGE TSUNAMI

“Over the past decade, an ocean of ink has been spilled over the problem of population aging in the world’s richest societies (Western Europe, Japan and North America). Low-income regions have attracted relatively little attention: Yet over the coming decades a parallel, dramatic ‘graying’ of much of the Third World also lies in store, and it promises to be a far uglier affair than the ‘aging crisis’ facing affluent societies. The burdens of aging simply cannot be borne as easily by the poor; low-income societies and governments have far fewer options, and the options available are considerably less attractive. For some poor countries, the social and economic consequences could be harsh indeed: Graying could emerge as a factor directly constraining long-term growth and development. In fact, rapid and pronounced population aging may represent one of the most least appreciated long-term risks facing many of today’s developing economies.”

Eberstadt N. *Wall Street Journal.* November 15, 2005

Noted by JFL, MD

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1990–2002**

Brenda J. Shields and Gary A. Smith

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