

CATASTROPHIC  
SPORTS INJURY RESEARCH

TWENTY-SIXTH ANNUAL REPORT

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## **Introduction**

In 1931 the American Football Coaches Association initiated the First Annual Survey of Football Fatalities and this research has been conducted at the University of North Carolina at Chapel Hill since 1965. In 1977 the National Collegiate Athletic Association initiated a National Survey of Catastrophic Football Injuries, which is also conducted at the University of North Carolina. As a result of these research projects important contributions to the sport of football have been made. Most notable have been the 1976 rule changes, the football helmet standard, improved medical care for the participants, and better coaching techniques.

Due to the success of these two football projects the research was expanded to all sports for both men and women, and a National Center for Catastrophic Sports Injury Research was established in 1982. The decision to expand the research was based on the following factors:

1. Research based on reliable data is essential if progress is to be made in sports safety.
2. The paucity of information on injuries in all sports.
3. The rapid expansion and lack of injury information in women's sports.

For the purpose of this research the term catastrophic is defined as any severe injury incurred during participation in a school/college sponsored sport. Catastrophic will be divided into the following three definitions:

1. **Fatality**
2. **Non-Fatal** - permanent severe functional disability.
3. **Serious** - no permanent functional disability but severe injury. An example would be fractured cervical vertebra with no paralysis.

Sports injuries are also considered direct or indirect. The definition for direct and indirect is as follows:

**Direct** - Those injuries that resulted directly from participation in the skills of the sport.

**Indirect** - Those injuries that were caused by systemic failure as a result of exertion while participating in a sport activity or by a complication that was secondary to a non-fatal injury.

## **Data Collection**

Data were compiled with the assistance of coaches, athletic trainers, athletic directors, executive officers of state and national athletic organizations, online news reports, and professional associates of the researchers. Data collection would not have been possible without the support of the National Collegiate Athletic Association (NCAA) the National Federation of State High School Associations (NFHS), and the American Football Coaches Association (AFCA). Upon receiving information concerning a possible catastrophic sports injury, contact by telephone, personal letter and questionnaire was made with the injured player's coach or athletic director. Data collected included background information on the athlete (age, height, weight, experience, previous injury, etc.), accident information, immediate and post-accident medical care, type injury and equipment involved. Autopsy reports are used when available.

In 1987, a joint endeavor was initiated with the Section on Sports Medicine of the American Association of Neurological Surgeons. The purpose of this collaboration was to enhance the collection of medical data. Dr. Robert C. Cantu, Chairman, Department of Surgery and Chief, Neurosurgery Service, Emerson Hospital, in Concord, MA, has been responsible for evaluating the medical data. Dr. Cantu is also a Past-President of the American College of Sports Medicine.

## **Summary**

### **Fall Sports** (Tables I - VIII)

#### **Football**

As indicated in Tables I through VIII, football is associated with the greatest number of catastrophic injuries. For the 2007 football season there were a total of 32 high school direct catastrophic injuries, which is an increase of 12 over 2006. College football was associated with seven direct catastrophic injuries in 2007, which is an increase of one over the 2006 data.

In 1990, as shown in the **Annual Survey of Football Injury Research 1931-2008**, there were no fatalities directly related to football. The 1990 football report is historic in that it is the first year, and the only year, since the beginning of the research in 1931 that there has not been a

direct fatality in football at any level of play. This clearly illustrates that this type of data collection and constant analysis of the data is important and plays a major role in injury prevention. The 1994 data shows zero fatalities at the high school level and one at the college level. In 2006 there was one high school direct fatality none at the college level. These numbers are very low when one considers that there were 36 football direct fatalities in 1968.

In addition to the direct fatalities in 2007 there were also seven indirect fatalities. Six of the indirect fatalities were at the high school level and one was at the college level. Heart and heat related deaths continue to be the cause of a majority of indirect deaths.

In addition to the fatalities there were 10 permanent disability injuries in 2007, and all ten were at the high school level. Six were cervical spine injuries and four were brain injuries. This number is a decrease of five when compared to the 2006 data.

Serious football injuries with no permanent disability accounted for 26 injuries at the high school and college levels in 2007 – 19 at the high school level and seven at the college level.

The decrease in catastrophic football injuries during the 1990s illustrates the importance of data collection and being sure that the information is passed on to those responsible for conducting football programs. A return to the injury levels of the 1960's and 1970's would be detrimental to the game and the participants, but the increase in the number of catastrophic injuries in 2007 is a concern and must be watched carefully.

### **Cross Country**

Cross-country was not associated with any direct injuries in 2007. There was one indirect death and one indirect injury with recovery at the high school level. For the 26 years indicated in Tables I through VIII, cross-country was associated with one direct non-fatal injury and 25 indirect fatalities at the high school level, and one indirect fatality at the college level. Twenty-four of the indirect fatalities were heart related, one was caused by a seizure, and the cause of one was unknown. Autopsy reports revealed congenital heart disease in four of these cases. The one indirect serious injury was heat stroke with recovery.

## **Soccer**

Table I shows that high school soccer had one direct catastrophic injury in 2007 and a total of 17 direct catastrophic injuries for the past 26 seasons. The direct injury was a brain injury to a female. The three direct catastrophic injuries in 1992 were the highest number in the past 26 years. There were two high school soccer indirect fatalities in 2007. Both indirect injuries were fatalities related to the heart. In 2007 college soccer was not associated with any direct or indirect catastrophic injuries.

Concussion injuries related to heading is a controversial area in soccer. There are helmet manufacturers that are now making soccer helmets to protect the participants from brain injuries while heading, even though the research indicates that concussion injuries during heading are related to head-to-head contact and not ball contact. In a special edition of the *Journal of Athletic Training*, July-September 2001, an article by Donald Kirkendall and William Garrett, Jr. the authors stated that it is difficult to blame purposeful heading for the reported cognitive deficits when actual heading exposure and details of the nature of head-ball impact are unknown. They go on to say that concussions are a common head injury in soccer (mostly from head-head or head-ground impact) and a factor in cognitive deficits and are probably the mechanism of the reported dysfunction. In October 2001 the Institute of Medicine at the National Academy of Sciences held a one-day conference. Experts on head injuries discussed the potential risk of heading, but reached no firm conclusions. The American Academy of Pediatrics issued the following recommendation in March 2000: "The potential for permanent cognitive impairment from heading the ball needs to be explored further. Currently, there seems to be insufficient published data to support a recommendation that young soccer players completely refrain from heading the ball. However, adults who supervise participants in youth soccer should minimize the use of the technique of heading the ball until the potential for permanent cognitive impairment is further delineated." In July of 2003 the National Federation of State High School Associations approved a rule that will allow soccer players to wear a head guard. Prior to this

rule only goalkeepers could wear such a device. The National Center will keep abreast of this controversial area.

In 2005 there was another case of a child being struck by the goal post and dying. A 15 year old male was struck in the head by a goal post that fell over and struck him in the head. This type of accident should never happen. The Consumer Product Safety Commission has stated that there have been at least 34 deaths and 51 injuries from falling soccer goal posts between 1979 and 2008 – at least seven deaths since 1998. There have been another 1,800 kids treated in emergency rooms due to injuries from movable soccer goals during that same period of time. The latest was an eight year-old boy who was hit by the goal post cross bar. Most occurred with moveable goal posts and resulted from errors in moving the structures or anchoring them. Soccer goal posts should be anchored to the ground and only moved by responsible adults. Players should not climb on the goal posts or hang on the crossbars.

### **Field Hockey**

In 1988 field hockey was associated with its first catastrophic injury since the study began in 1982. It was listed as a serious injury at the college level. The athlete was struck by the ball after a free hit. She received a fractured skull, had surgery and has recovered from the injury. The 1996 data showed two field hockey direct injuries at the high school level. Both injuries involved being hit by the ball and resulted in a head and an eye injury. The 1999 data show one non-fatal injury at the high school level and one serious injury at the college level. The high school injury involved the loss of an eye after being hit with the stick during a drill, and the college injury resulted in a fractured skull after being hit by a ball. There were no direct catastrophic injuries in high school or college field hockey during the 2007 season. There has been only one indirect catastrophic injury in field hockey since the beginning of the study in 1982, and that happened during the 2007 season. A player collapsed on the field during a practice and died.

## **Water Polo**

In 1992-93 high school water polo was associated with its first indirect fatality and in 1988-89 college water polo had its first indirect fatality. There have been a total of four high school indirect fatalities in water polo and one at the college level. There were no water polo fatalities in 2007.

## **Fall Summary**

In summary, high school fall sports in 2007 were associated with 33 direct catastrophic injuries. Thirty-two were associated with football and one in soccer. Football had three fatalities, ten involved permanent disability, and 19 were considered serious. For the 26-year period 1982-1983 – 2007-2008, high school fall sports had 656 direct catastrophic injuries and 635, or 96.8%, were related to football participants. In 2007 high school fall sports were also associated with 11 indirect fatalities. Two were in cross country, six in football, two in soccer, and one in field hockey. For the period from 1982-1983 – 2007-2008 there was a total of 242 indirect fall high school catastrophic injuries. Two-hundred and forty of the indirect injuries were fatalities and 177 were related to football. Seventeen of the indirect fatalities involved females – six soccer players, one water polo player, one field hockey player, and nine cross-country athletes. Females were also associated with five direct catastrophic injuries – three in field hockey and two in soccer..

During the 2007 college fall sports season there were seven direct catastrophic injuries- all in football and all listed as serious. For the 26 years, 1982-2007, there were a total of 146 college direct fall sport catastrophic injuries, and 140 were associated with football. Three were associated with soccer and three with field hockey. There was one indirect college fatality during the fall of 2007 and it was associated with football. From 1982 through the 2007 fall season there were a total of 50 college fall sport indirect catastrophic injuries, and 49 of them were fatalities. Forty-two of the indirect fatalities were associated with football, six in soccer, one in cross country, and one in water polo. College females were associated with four direct

catastrophic injuries – three in field hockey and one in soccer. College females were also associated with three indirect fatalities in soccer.

High school football accounted for the greatest number of direct catastrophic injuries for the fall sports, but high school football was also associated with the greatest number of participants. There are approximately 1,500,000 high school and middle school football players participating each year. As illustrated in Table II, the 26-year rate of direct injuries per 100,000 high school and middle school football participants was 0.29 fatalities, 0.75 non-fatal injuries and 0.74 serious injuries. These catastrophic injury rates for football are higher than those for both cross-country and soccer, but all three classifications of catastrophic football injuries have an injury rate of less than one per 100,000 participants. Table IV shows that the indirect fatality rates for high school football, soccer and cross country are similar and are also less than one per 100,000 participants. Water polo rates are higher, but are based on only 16 years of data, and water polo has approximately 25,000 male and female participants each year.

College football has approximately 75,000 participants each year and the direct injury rate per 100,000 participants is higher than the other fall sports. The rate for the 26-year period indicated in Table VI, for college football fatalities is less than one per 100,000 participants, but the rate increases to 1.81 per 100,000 for non-fatal injuries and 4.98 per 100,000 participants for serious injuries.

Indirect fatality rates are similar in college cross-country and soccer, increase in football, with water polo being associated with the highest indirect fatality rate. Based on 20 years of data, water polo has approximately 1790 participants each year (Table VIII).

There were four college female athletes receiving a direct catastrophic injury in a fall sport for this 26-year period of time. There was one non-fatal injury and two serious injuries in field hockey, and one non-fatal injury in soccer. There were also three female indirect deaths and all three were in soccer.

Incidence rates are based on 26-year participation figures received from the National Federation of State High School Associations and the National Collegiate Athletic Association. (Figure I)

### **Winter Sports** (Tables IX - XVI)

As shown in Table IX, high school winter sports were not associated with any direct catastrophic injuries in 2007-2008. High school winter sports were associated with seven indirect fatalities during the 2007-2008 school year (Table XI). Basketball was associated with six (3 males and 3 females), and wrestling was associated with one. All seven resulted in death and were heart related.

College winter sports, Tables XIII - XVI, were not associated with any direct catastrophic injuries during the 2007-2008 school year. During this same time period there were three indirect fatalities. Two of the indirect fatalities were associated with swimming (1 male and 1 female), and one male in basketball. All of the indirect injuries resulted in death.

A summary of high school winter sports, 1982-1983 – 2007-2008, show a total of 123 direct catastrophic injuries (7 fatalities, 66 non-fatal, and 50 serious) and 156 indirect. Wrestling was associated with 58 or 47.2 % of the direct injuries. Gymnastics was associated with 13, or 10.6%, of the direct injuries. Basketball was associated with 19 (15.4%), ice hockey was associated with 19 (15.4%), swimming was associated with 13 (10.6%) direct injuries, and volleyball one (0.81%). Basketball accounted for the greatest number of indirect catastrophic injuries with 120, or 77.0%, of the winter total.

College winter sports from 1982-1983 – 2007-2008 were associated with a total of 30 direct catastrophic injuries. Gymnastics was associated with six (20.0%), ice hockey 12 (40.0%), basketball nine (30.0%), swimming one (3.3%), skiing one (3.3%) and wrestling one (3.3%). There were also 46 indirect injuries (44 fatalities) during this time period. Thirty, or 65.2%, were associated with basketball, three in wrestling, two in ice hockey, eight in swimming, one in skiing, one in gymnastics, and one in volleyball.

High school wrestling accounted for the greatest number of winter sport direct injuries, but the injury rate per 100,000 participants was less than one for all three categories. High school wrestling has averaged approximately 239,000 male and 1,700 female participants each year. High school basketball and swimming were also associated with low direct injury rates. As shown in Table X, ice hockey and gymnastics, for both males and females, were associated with the highest injury rates for the winter sports. Gymnastics has averaged approximately 3,800 males and 24,500 female participants during the past twenty-six years. Ice hockey averages 27,800 male and 2,789 female participants each year. A high percentage of the ice hockey injuries involve a player being hit by an opposing player, usually from behind, and striking the skate rink boards with the top of his/her head.

Indirect high school catastrophic injury rates, as indicated in Table XII, are all below one per 100,000 participants.

Catastrophic direct injury rates for college winter sports are higher when compared to high school figures. Gymnastics had five non-fatal and one serious injury for the past twenty-six years, but the injury rate is 20.07 per 100,000 participants for non-fatal male injuries, and 5.35 per 100,000 for female non-fatal injuries. Participation figures show approximately 597 male and 1,493 female gymnastic participants each year.

College ice hockey was associated with eight serious (one female) and four non-fatal injuries in twenty-six years, but the injury rate is 4.02 per 100,000 male participants for non-fatal and 7.03 for male serious injuries. There are approximately 3,800 male ice hockey participants each year. The first female college ice hockey player received a direct serious injury during the 1999-2000 season. The serious injury rate for females was 5.77 injuries per 100,000 participants and females averaged approximately 665 participants per year for the past 26 years. Swimming non-fatal incidence rates were not as high as gymnastics or ice hockey, but could be totally eliminated if swimmers would not use the racing dive into the shallow end of pools during practice or meets. In fact there has not been a direct injury in college swimming since the one non-fatal injury in 1982-1983.

College wrestling had only one direct catastrophic injury from the fall of 1982 to the spring of 2008. For this period of time there were 175,353 participants in college wrestling for an average of approximately 6,744 per year. The injury rate for this twenty-six year period of time was 0.57 per 100,000 participants. College skiing has approximately 580 female participants each year and the one fatality in 1989-1990 produced a nineteen-year injury rate of 6.64 per 100,000 participants. This was the only skiing direct fatality since the study was initiated.

Injury rates for male college indirect fatalities were high when compared to the high school rates. Basketball had an injury rate of 6.94 fatalities per 100,000 male participants, skiing 5.91, ice hockey 1.00, and swimming 2.95. The year 1997-98 was the first year there were any indirect fatalities in wrestling. There were three deaths due to heat stroke associated with wrestlers trying to make weight for a match. The indirect injury rate for wrestling was 1.71 per 100,000 participants.

The female indirect injury rate for basketball was 0.91 per 100,000 participants, 0.55 per 100,000 for volleyball, 0.86 for swimming and 2.58 for gymnastics.

### **Spring Sports** (Tables XVII - XXIV)

High school spring sports were associated with six direct catastrophic injuries in 2008. There were two catastrophic injuries in baseball, three in lacrosse, and one in track. High school spring sports were also associated with one indirect catastrophic injury in 2008. The indirect fatal injury was in track.

College spring sports were not associated with any direct or indirect catastrophic injuries in 2008.

From 1983 through 2008, high school spring sports were associated with 126 direct catastrophic injuries (Table XVII). Thirty-four were listed as fatalities, 39 as catastrophic non-fatal and 53 as serious. Baseball accounted for 49, track 61, lacrosse 12, and softball four. Injury rates were less than one per 100,000 participants for each sport in all categories. There

were eight direct injuries to females in track, four in softball, and one in lacrosse. There were also 60 indirect fatalities in high school spring sports during this time span (Table XIX). Thirty-five were related to track, 14 in baseball, seven in lacrosse, three in tennis, and one in golf. Six of the indirect fatalities involved female track athletes.

As illustrated in Table XXI, college spring sports were associated with 35 direct catastrophic injuries from 1983 to 2008. Eleven of these injuries resulted in fatalities, 13 were listed as non-fatal and 11 were listed as serious. Baseball accounted for twelve injuries, lacrosse eleven, track ten, softball one, and equestrian one. College females were associated with two non-fatal injuries in lacrosse, one in track, a serious injury in softball, and one fatality in equestrian. Table XXIII shows that there were also ten indirect fatalities in college spring sports during this time. Two indirect fatalities were associated with tennis, one was associated with track, two in baseball, three in rowing, and two in lacrosse. There was one female fatality in tennis.

Injury rates for high school spring sport direct injuries were low as illustrated in Table XVIII. Baseball participation reveals an average of approximately 419,000 male players and 900 female players each year, track 510,000 males and 413,000 females, and tennis 141,000 males and 147,000 females. The baseball figures do not include the 313,000 female softball participants each year (plus 1,100 males). Lacrosse has approximately 33,000 male and 22,000 female participants each year. Injury rates, as shown in Table XX, for high school indirect injuries are also low.

College spring sports, Table XXII, are related to low injury rates for direct injuries, with the exception of equestrian and men's lacrosse. Men's lacrosse had four fatalities, three non-fatal and two serious injuries and the injury rates were higher than the other college spring sports. Female lacrosse players were associated with two non-fatal injuries and female track (pole vault) was associated with one non-fatal injury. Equestrian was associated with a female fatality. Participation figures reveal approximately 5,819 men and 4,000 women lacrosse players each year. The 1991 and 2003 injuries were to female lacrosse players.

Rates for indirect college fatalities in baseball, tennis, and track are low with lacrosse being slightly higher. There were two indirect tennis fatalities, one male and one female, but participation figures are low. Men average approximately 7,600 and women 7,800 participants each year. Men's rowing had the highest indirect injury rate at 21.27 injuries per 100,000 male participants and 0.00 for female participants. There are approximately 2,000 male rowers and 6,700 female rowers each year.(Table XXIV)

## **Discussion**

Football is associated with the greatest number of catastrophic injuries for all sports, but the incidence of injury per 100,000 participants is higher in both gymnastics and ice hockey. There have been dramatic reductions in the number of football fatalities and non-fatal catastrophic injuries since 1976 and the 1990 data illustrated an historic decrease in football fatalities to zero. This is a great accomplishment when compared to the 36 fatalities in 1968. This dramatic reduction can be directly related to data collected by the American Football Coaches Association Committee on Football Injuries (1931-2008) and the recommendations that were based on that data. Non-fatal football injuries, permanent disability, decreased to one for college football in 1995, 1999, 2004, 2005, and zero in 2007. There was a dramatic reduction in high school football from 13 in 1990 and 1993 to seven in 2002, and six in 2005. The 2006 data shows 15 non-fatal injuries (head and neck combined) and one fatality in high school football. The 15 non-fatal injuries is the highest number since the 1989 season when there were 18. Fifteen is a dramatic increase over the six high school non-fatal injuries in 2005. The 2007 data show 10 head and neck disability injuries in high school football. Permanent disability injuries in football have seen dramatic reductions when compared to the data from the late 1960's and early 1970's, but a continued effort must be made to eliminate these injuries. In addition, there were four serious injuries in high school football in 2006, but a dramatic rise to 19 in 2007. All of the serious cases involved head or neck injuries and in a number of these cases excellent medical care saved the athlete from permanent disability or death. College football in 2007 was

associated with a total of seven catastrophic injuries – all seven were serious head or neck injuries with full recovery.

Football catastrophic injuries may never be totally eliminated, but progress has been made. Emphasis should again be focused on the preventive measures that received credit for the initial reduction of injuries.

1. The 1976 rule change which prohibited initial contact with the head in blocking and tackling. There must be continued emphasis in this area by coaches and officials.
2. The NOCSAE football helmet standard that went into effect at the college level in 1978 and at the high school level in 1980. There should be continued research in helmet safety.
3. Improved medical care of the injured athlete. An emphasis on placing certified athletic trainers in all high schools and colleges. There should be a written emergency plan for catastrophic injuries both at the high school and college levels.
4. Improved coaching technique when teaching the fundamental skills of blocking and tackling.

#### **Keeping the head out of blocking and tackling!**

**A major concern in football fatalities has been the number of indirect deaths due to heat stroke, both at the college and high school levels. During the past ten years there have been 26 heat stroke deaths in football. This number is unacceptable since heat stroke deaths are preventable with the proper precautions. Every effort should be made to continuously educate coaches concerning the proper procedures and precautions when practicing or playing in the heat. In the Annual Survey of Football Injury Research – 1931-2007 there are recommendations for safety during football activity in hot weather. New regulations by the National Collegiate Athletic Association for volunteer summer conditioning programs and pre-season football practice went into effect during the 2003 season and it will be very interesting to see how they effect heat related injuries at the college level.**

It should be noted that from 1979 to 2008, according to the Consumer Product Safety Commission (CPSC), there have been 34 deaths and 51 injuries from movable soccer goals. The most recent case involved an eight year-old male playing on a soccer goal when it tipped over and hit his head, causing his death. Since 1998 there have been at least seven deaths and another 1,800 kids treated in emergency rooms because of injuries from movable soccer goals. There has been one fatality in this study, which involved a college athlete hanging on a soccer goal and the goal falling and striking the victim's head. The CPSC recommends the following safety measures related to movable soccer goal safety:

1. Teach kids to never climb on the netting or crossbar of a soccer goal
2. Soccer goals should be securely anchored to the ground with stakes, an auger anchor, or counterweights, such as sandbags, and that they are checked before games and practices
3. Place soccer goals on a flat surface, which may make it less likely to tip over
4. When not in use remove soccer goal nets and anchored or chained to a fence post, dugout, or other sturdy fixture, so kids cannot move or play on them without supervision
5. Take soccer goals apart and store at the end of a season so kids cannot play on them

On May 4, 1999, the Consumer Product Safety Commission and the soccer goal industry announced the development of a new safety standard that will reduce the risk of soccer goal tip-over. The ‘Provisional Safety Standard and Performance Specification for Soccer Goals’ (ASTM-PS-75-99) requires that movable soccer goals, except very lightweight goals, not tip over when the goal is weighted in a downward or horizontal direction. The standard also specifies warning labels must be attached to the goal, such as: “Warning: Always anchor goal. Unsecured goal can fall over causing serious injury or death.” For a free copy of: “Guidelines for Movable Soccer Goal Safety,” send a postcard to CPSC, Washington, DC 20207. Also available online: <http://cpsc.gov>.

A Loss Control Bulletin from K & K Insurance Group, Inc., Fort Wayne, IN, suggests the following safeguards:

1. Keep soccer goals supervised and anchored.
2. Never permit hanging or climbing on a soccer goal.
3. Always stand to the rear or side of the goal when moving it - NEVER to the front.
4. Stabilize the goal as best suits the playing surface, but in a manner that does not create other hazards to players.
5. Develop and follow a plan for periodic inspection and maintenance (e.g., dry rot, joints hooks).
6. Advise all field maintenance persons to re-anchor the goal if moved for mowing the grass or other purposes.
7. Remove goals from field no longer in use for the soccer program as the season progresses.
8. Secure goals well from unauthorized access when stored.
9. Educate and remind all players and adult supervisors about the past tragedies of soccer goal fatalities.

There is also a list of guidelines available for movable soccer goal safety and warning labels. To obtain a copy contact the following:

The Coalition to Promote Soccer Goal Safety  
C/O Soccer Industry Council of America  
200 Castlewood Drive  
North Palm Beach, FL 33408

High school wrestling, gymnastics, ice hockey, baseball and track should receive close attention. Wrestling has been associated with 58 direct catastrophic injuries during the past twenty-six years. Due to the fact that college wrestling was only associated with one catastrophic injury during this same time period, continued research should be focused on the high school level. High school wrestling coaches should be experienced in the teaching of the

proper skills of wrestling and should attend coaching clinics to keep up-dated on new teaching techniques and safety measures. They should also have experience and training in the proper conditioning of their athletes. These measures are important in all sports, but there are a number of contact sports, like wrestling, where the experience and training of the coach is of the utmost importance. Full speed wrestling in physical education classes is a questionable practice unless there is proper time for conditioning and the teaching of skills. The physical education teacher should also have expertise in the teaching of wrestling skills. It should also be emphasized that wrestling coaches need to be aware of the dangers associated with athletes making weight. Improper weight reduction can lead to serious injuries and death. During the 1997-1998 academic year there were three college wrestlers that died while trying to make weight for a match. All three died of heat stroke complications. These were the first wrestling deaths associated with weight reduction; however, there is no information on the number of wrestlers who had medical problems associated with weight loss, but recovered. All three of these wrestlers were trying to lose large amounts of weight in a short period of time. All three were also working out in areas of high heat, and were all wearing sweat clothes or rubber suits. Making weight has always been a part of the wrestling culture, but it is dangerous and life threatening. New rule changes went into effect for the 1998-99 high school and college seasons, and hopefully, making weight will be a thing of the past and will never result in the deaths of young high school or college athletes. A significant rule change approved by the NFHS Board of Directors in April 2005, states that in 2006-07 stronger guidelines discouraging rapid weight loss will take effect. The revised rule includes a specific gravity not to exceed 1.025, a body fat assessment no lower than 7 percent (males)/12 percent (females) and a monitored, weekly weight loss plan not to exceed 1.5% a week.

There is also a national trend for an increased number of females participating in wrestling. In 2007-2008 there were 5,527 females in high school wrestling. A new rule in high school wrestling for the 2007-2008 season states that each contestant who has braces or a special orthodontic device on his or her teeth, shall be required to wear a tooth and mouth protector. A

rule clarification was made on communicable skin conditions or any other condition, in that the current written documentation from a physician needs to be on an approved form from either the NFHS or a state association. Communicable skin conditions were also a point of emphasis in the 2007-2008 rule book.

Men's and women's gymnastics and ice hockey were associated with higher injury rates at both the high school and college levels. Gymnastics needs additional study at both levels of competition. Both levels have seen a dramatic participation reduction and this trend may continue with the major emphasis being in private clubs. Lacrosse also had a higher injury rate at the college level.

Ice hockey injuries are low in numbers but the injury rate per 100,000 participants is high when compared to other sports. Ice hockey catastrophic injuries usually occur when an athlete is struck from behind by an opponent, slides across the ice in a prone position, and makes contact with the crown of his/her head and the boards surrounding the rink. The results are usually fractured cervical vertebrae with paralysis. Research in Canada has revealed high catastrophic injury rates with similar results. After an in-depth study of ice hockey catastrophic injuries in Canada, Dr. Charles Tator has made the following recommendations concerning prevention:

1. Enforce current rules and consider new rules against pushing or checking from behind
2. Improve strength of neck muscles.
3. Educate players concerning risk of neck injuries.
4. Continued epidemiological research.

Catastrophic injuries in swimming were all directly related to the racing dive in the shallow end of pools. There has been a major effort by both schools and colleges to make the racing dive safer and the catastrophic injury data support that effort. There has not been a college injury for the past 25 years. High school swimming has been associated with 13 catastrophic injuries and the racing dive in the shallow end of the pool has been involved in all cases. It is a fact that the swimming community has been made aware of the problem with the racing dive into the shallow end of the pool, and along with rule changes and coach's awareness, there have been

no catastrophic injuries in swimming during the past six years. The competitive racing start has changed and now involves the swimmer getting more depth when entering the water. Practicing or starting competition in the deep end of the pool or being extremely cautious could eliminate catastrophic injuries caused by the swimmer striking his/her head on the bottom of the pool. The National Federation of State High School Associations Swimming and Diving Rules Book (Rule 2-7-2) states that in pools with water depth less than three and one-half feet at the starting end, swimmers will have to start the race in the water. The rules read that in four feet or more of water, swimmers may use a starting platform up to a maximum of 30 inches above the water, and the pool depth shall be measured for a distance of 16 feet, 5 inches from the end wall. Between three and one-half and less than four feet, swimmers start from the pool deck or in the water. If the water is less than three and one-half feet deep swimmers must start the race in the water. The National Collegiate Athletic Association and USA Swimming have or are in the process of moving standards for use of starting blocks to a minimum depth of five feet. In April 1995 the National Federation revised rule 2-7-2, which now states that starting platforms shall be securely attached to the deck/wall in pools with water depth of four feet or more in the starting end. If they are not, they shall not be used and deck or in-water starts will be required. These new rules point out the importance of constant data collection and analysis. Rules and equipment changes for safety reasons must be based on reliable injury data. The National Center has not received any information concerning high school or college direct catastrophic swimming injuries during the 2007-2008 season.

High school spring sports have been associated with low incidence rates during the past twenty-six years, but baseball was associated with 49 direct catastrophic injuries and track 60. A majority of the baseball injuries have been caused by the head first slide or by being struck with a thrown or batted ball. If the headfirst slide is going to be used, proper instruction should be involved. Proper protection for batting practice should be provided for the batting practice pitcher and he/she should always wear a helmet. This should also be true for the batting practice coach. During the 2008 baseball season two high school pitchers were stuck in the head with

batted balls and both recovered. Both were pitching batting practice, were behind screens, but did not get fully behind the screens when the balls were hit. A new rule in fast pitch soft ball will require players to wear batting helmets equipped with NOCSAE approved facemasks/guards. The rule went into effect January 1, 2006.

The pole vault was associated with a majority of the fatal track injuries. There have been 19 high school and college fatal pole-vaulting injuries from 1983 to 2007. This includes the high school coach who was demonstrating in 1998, bounced out of the pit, struck his head on concrete, and died. In addition to the fatalities there were also eleven permanent disability (8 high school and 3 college) and seven serious injuries (5 high school, one college, and one middle school). All 37 of these accidents involved the vaulter bouncing out of or landing out of the pit area. There was one high school one pole vaulting death in 2008. The three pole vaulting deaths in 1983 were a major concern and immediate measures were taken by the National Federation of State High School Associations. Beginning with the 1987 season all individual units in the pole vault landing area had to include a common cover or pad extending over all sections of the pit.

In 2001 there was a pole vaulting injury to a female college athlete. The athlete was vaulting indoors, bounced out of the pit, and hit her head on the floor. She had an epidural hematoma and a posterior skull fracture. At the time of the accident it was not possible to determine the extent of any long-term disability.

Whenever there is a pole vaulting death there are more proponents of eliminating the event. The crux of the opposition appears to be the potential liability and also the lack of qualified coaches to teach the pole vault. Additional recommendations in the 1991 rule book included stabilizing the pole-vault standards so they cannot fall into the pit, pad the standards, remove all hazards from around the pit area, and control traffic along the approach. Obvious hazards like concrete or other hard materials around the pit should be eliminated. In the National Federation of State High Schools Track and Field Rules Book, Section 4, Article 10, it states as follows: Hard or unyielding surfaces, such as but not limited to concrete, metal, wood or asphalt around the landing pad, or between the planting box and the landing pad, shall be padded or

cushioned with a minimum of two (2) inches of dense foam or other suitable material. It is also recommended that any excess material such as asphalt or concrete that extends out from beneath the landing pad be removed.

Due to the numbers of pole vaulting injuries there have also been a number of recommendations stating that pole vaulters should wear helmets. The National Federation of State High School Associations has made the following statement concerning pole vaulting helmet use: The NFHS has been asked if it would be permissible for high school students to wear some type of helmet while pole vaulting and they stated that it would be permissible for an athlete to wear a helmet of his/her choosing without violating the NFHS rules. A helmet designed exclusively for pole vault, the KDMax, was released in October 2004. Six state high school associations already require some type of helmet for pole vaulters, and 30 states indicated on the 2004 NFHS track and field survey that they would support mandatory helmet use if a national standard was in place. In the NCAA helmets will continue to be an option for pole vaulters.

It has been estimated that there are approximately 25,000 high school pole vaulters annually. If this number were correct, the catastrophic injury rate for high school pole vaulters would be higher than any of the sports included in the research. An outside group estimates that there may be as many as 77,390 high school male and female pole vaulters. Either number is only an estimate. There is no doubt that if the 77,390 number is used the incidence rate would be less than if the 25,000 number is used. The important point is that there were 37 catastrophic injuries in pole vaulting, rule changes were made, and the safety rules have been proven effective. Continued surveillance should be maintained, and high school coaches and officials should be aware of the National Federation rules pertaining to the pole vault – size of the landing system, weight of competitor and pole rating, etc.

There have also been 24 accidents in high school track involving participants being struck by a thrown discus, shot put or javelin. In 1992, a female athlete was struck by a thrown discus in practice and died. In 1993, a track manager was struck in the neck by a javelin, but he

was lucky and completely recovered from the accident. In 1994, a female track athlete was struck in the face by a javelin and will recover. In 1995, a male athlete was struck in the head by a shot put during warm-ups and had a fractured skull. In 1997, a male athlete was struck by a discus and died. In 1998 a female athlete was struck by a discus and died, and a male athlete was struck in the head by a shot-put and recovered. In 1999 a male athlete was struck by a javelin and a female athlete was struck by a discus. In 2000 a junior high school athlete was struck in the head by a discus and has permanent disability. In 2001 a high school athlete was struck in the cheek with a javelin during practice. In 2002 there were three athletes struck by a shot putt and one by a discus. In 2002 there was also a coach that was struck by a shot putt. In 2004 a male track athlete was hit in the head with a shot putt and was in critical condition. In 2005 a track athlete was impaled with a javelin in the shoulder. In 2006 a male track athlete was hit in the head with a javelin which went four inches into his brain. He was very lucky and recovered. In 2007 a female track athlete was struck in the ankle by a javelin and needed a bone graft, and another female was struck in the head by a shot put, had surgery, and recovered. There have also been spectators struck by the discus during high school meets. On June 23, 2005, a 77 year old official died after being struck in the head by a shot put while athletes were practicing for the US championships. Safety precautions must be stressed for these events in both practice and competitive meets with the result being the elimination of this type of accident. The National Federation of State High School Associations put a new rule in for the 1993 track season that fenced off the back and sides of the discus circle to help eliminate this type of accident. Good risk management should eliminate these types of accidents. These types of injuries are not acceptable and should never happen.

The 2008 track and field rule book point of emphasis on risk minimization highly recommended emphasis on safety in the following areas:

1. Proper administration and appropriate restricted areas in all throws and jumps
2. Hydration of all athletes
3. Well-marked restricted areas for all running events

4. Well-marshaled areas to encourage positive spectator behavior
5. Schools are encouraged to have a copy of the rule book to serve as a resource to properly train individuals assisting with meet administration

The fatality in high school lacrosse during the 1987 season was associated with a player using his head to strike the opponent. He struck the opponent with the top or crown of his helmet. This technique is prohibited by the lacrosse rules and should be strictly enforced. In 2002 a high school lacrosse player was also blocking and suffered permanent paralysis. Lacrosse has been a fairly safe sport when considering the fact that high school lacrosse has been involved with 12 direct catastrophic injuries in twenty-six years. A possible new area of concern is the recent lacrosse deaths being associated with players being struck in the chest with the ball and causing death (commotio cordis). There have been seven cases (6 deaths) ( two high school, one high school club, three college, and one lacrosse summer camp) in the past ten years. The most recent commotio cordis death happened when the player was struck in the chest with the opponents stick. Currently there is research being funded by the National Operating Committee for Standards in Athletic Equipment that is studying chest protectors to help reduce commotio cordis fatalities. The lacrosse community will have to keep a close watch on these types of deaths and possibly carry out in-depth evaluations of these injuries.

There was a female college lacrosse player in 1993 that was hit in the eye with a ball and had permanent vision damage. In the spring of 2004 protective eyewear was required for all high school participants in states that follow NFHS rules, and for all competitors at the NCAA championships. In 2005, the requirement was extended to the entire season for all NCAA teams. Early reports indicate a major reduction in eye injuries for female lacrosse players.

During the 2008 high school lacrosse season there were three players with direct serious injuries. Two were hit in the chest by shots, had their hearts stop, but were saved by the use of CPR and AED. The third player was playing defense and hit an opponent with his head in a down position. He fractured cervical vertebra number seven, had two surgeries, wore a neck

brace for five weeks and recovered. Use of the head in lacrosse is against the rules, coaches should not teach it, and officials should call a penalty.

College spring sports are also associated with a low injury incidence. Injury rates are slightly higher in lacrosse but the participation figures are so low that even one injury will increase the incidence rate dramatically. It is important to point out that there have been nine college male and two female lacrosse catastrophic injuries during the past twenty-six years. The college death in 2005 involved a male player being struck in the neck by a ball. In a college club lacrosse game on October 15, 2005, there was a non-fatal catastrophic injury to a male participant. He was hit with a point blank range shot off of his helmet. The injury was a subdural hematoma and the athlete had surgery. There have been questions concerning the particular helmet the player was wearing at the time. There were no direct or indirect college lacrosse injuries in the 2007-2008. It should be mentioned that there is general concern about concussion injuries in lacrosse, and according to a study from Temple University, female lacrosse players have the highest percentage of concussions during a game, followed by women's soccer.

For the twenty-six year period from the fall of 1982 through the spring of 2008 there have been 1116 direct catastrophic injuries in high school and college sports. High school sports were associated with 152 fatalities, 379 non-fatal and 374 serious injuries for a total of 905. College sports accounted for 22 fatalities, 63 non-fatal and 126 serious injuries for a total of 211. During this same twenty-six year period of time there have been a total of 564 indirect injuries and all but twelve resulted in death. Four hundred and fifty-eight of the indirect injuries were at the high school level and 106 were at the college level. It should be noted that high school annual athletic participation for 2007-2008 includes approximately 7,429,381, athletes (4,372,115 males and 3,057,266 females). National Collegiate Athletic Association participation for 2007-2008 was 412,768 athletes. There were 236,774 males and 175,994 females.

During the twenty- six year period from the fall of 1982 through the spring of 2008 there have been 154,670,609 high school athletes participating in the sports covered by this report.

Using these participation numbers would give a high school direct catastrophic injury rate of 0.59 per 100,000 participants. The indirect injury rate is 0.30 per 100,000 participants. If both direct and indirect injuries were combined the injury rate would be 0.88 per 100,000. This means that approximately one high school athlete out of every 100,000 participating would receive some type of catastrophic injury. The combined fatality rate would be 0.39 per 100,000, the non-fatal rate 0.25, and the serious rate 0.25.

During this same time period there were approximately 8,454,483 college participants with a total direct catastrophic injury rate of 2.50 per 100,000 participants. The indirect injury rate is 1.25 per 100,000 participants. If both indirect and direct injuries were combined the injury rate would be 3.75. The combined fatality rate would be 1.48, the non-fatal rate 0.78, and the serious rate 1.50.

### **Female Catastrophic Injuries**

There have been a total of 112 direct and 56 indirect catastrophic injuries to high school, female athletes from 1982-83 – 2007-2008, which includes cheerleading. College females accounted for 44 direct and 11 indirect catastrophic injuries (including cheerleading) for the same time period. The 112 high school direct injuries included nine in gymnastics, 73 in cheerleading, five in swimming, four in basketball, eight in track, four in softball, three in field hockey, two in ice hockey, one in lacrosse, two in soccer, and one in volleyball. The 56 high school indirect fatalities included 15 in basketball, eight in swimming, six in track, six in soccer, nine in cross country, two in volleyball, one in water polo, one in field hockey, and eight in cheerleading. The 44 college direct injuries were associated with cheerleading(31), gymnastics(2), field hockey(3), soccer(1), skiing(1), ice hockey(1), track (pole vault)(1), equestrian(1), softball(1), and lacrosse(2). The 11 college indirect fatalities included one in tennis, three in basketball, three in soccer, one in gymnastics, two in swimming, and one in volleyball. Catastrophic injuries to female athletes have increased over the years. As an example, in 1982-83 there was one female catastrophic injury and during the past 26 years there

has been an average of 8.5 per year. A major factor in this increase has been the change in cheerleading activity, which now involves gymnastic type stunts. If these cheerleading activities are not taught by a competent coach and keep increasing in difficulty, catastrophic injuries will continue to be a part of cheerleading. High school cheerleading accounted for 65.2% of all high school direct catastrophic injuries to female athletes (two males not included) and 70.5% at the college level (four males not included). Of the 156 direct catastrophic injuries to high school and college female athletes from 1982-83 – 2007-2008, cheerleading was related to 104 or 66.7%. The cheerleading numbers have been updated from previous reports and male cheerleaders were not included. Read the special section on cheerleading.

Athletic administrators and coaches should place equal emphasis on injury prevention in both female and male athletics. Injury prevention recommendations are made for both male and female athletes.

Athletic catastrophic injuries may never be totally eliminated, but with reliable injury data collection systems and constant analysis of the data these injuries can be dramatically reduced.

**TABLE 1**  
**HIGH SCHOOL FEMALE DIRECT CATASTROPHIC INJURIES**  
**1982-83 – 2007-08**

<b>SPORT</b>	<b>FATALITY</b>	<b>NON-FATAL</b>	<b>SERIOUS</b>	<b>TOTAL</b>
Cheerleading*	2	25	46	73
Gymnastics	0	6	3	9
Track	1	1	6	8
Swimming	0	4	1	5
Basketball	0	1	3	4
Ice Hockey	0	0	2	2
Field Hockey	0	3	0	3
Softball	1	2	1	4
Lacrosse	0	0	1	1
Soccer	0	1	1	2
Volleyball	0	1	0	1
<b>TOTAL</b>	<b>4</b>	<b>44</b>	<b>64</b>	<b>112</b>

\* Cheerleading does not include two males

**TABLE 2**  
**HIGH SCHOOL FEMALE INDIRECT CATASTROPHIC INJURIES**  
**1982-83 – 2007-08**

<b>SPORT</b>	<b>FATALITY</b>	<b>NON-FATAL</b>	<b>SERIOUS</b>	<b>TOTAL</b>
Basketball	14	0	1	15
Swimming	7	0	1	8
Cheerleading	7	0	1	8
Cross Country	9	0	0	9
Soccer	6	0	0	6
Track	6	0	0	6
Volleyball	1	1	0	2
Water Polo	1	0	0	1
Field Hockey	1	0	0	1
<b>TOTAL</b>	<b>52</b>	<b>1</b>	<b>3</b>	<b>56</b>

**TABLE 3**  
**COLLEGE FEMALE DIRECT CATASTROPHIC INJURIES**  
**1982-82 – 2007-08**

<b>SPORT</b>	<b>FATALITY</b>	<b>NON-FATAL</b>	<b>SERIOUS</b>	<b>TOTAL</b>
Cheerleading*	1	11	19	31
Field hockey	0	1	2	3
Lacrosse	0	2	0	2
Gymnastics	0	2	0	2
Equestrian	1	0	0	1
Soccer	0	1	0	1
Ice Hockey	0	0	1	1
Skiing	1	0	0	1
Track (Pole Vault)	0	1	0	1
Softball	0	0	1	1
<b>TOTAL</b>	<b>3</b>	<b>18</b>	<b>23</b>	<b>44</b>

\*Cheerleading does not include four males

**TABLE 4**  
**COLLEGE FEMALE INDIRECT CATASTROPHIC INJURIES**  
**1982-83 – 2007-08**

<b>SPORT</b>	<b>FATALITY</b>	<b>NON-FATAL</b>	<b>SERIOUS</b>	<b>TOTAL</b>
Soccer	3	0	0	3
Basketball	3	0	0	3
Tennis	1	0	0	1
Volleyball	1	0	0	1
Gymnastics	1	0	0	1
Swimming	2	0	0	2
<b>TOTAL</b>	<b>11</b>	<b>0</b>	<b>0</b>	<b>11</b>

### **Recommendations for Prevention**

1. Mandatory medical examinations and a medical history taken before allowing an athlete to participate.
2. All personnel concerned with training athletes should emphasize proper, gradual and complete physical conditioning in order to provide the athlete with optimal readiness for the rigors of the sport.
3. Every school should strive to have a certified athletic trainer who is a regular member of the faculty and is adequately prepared and qualified. There should be a written emergency procedure plan to deal with the possibility of a catastrophic injury.
4. There should be an emphasis on employing well trained athletic personnel, providing excellent facilities and securing the safest and best equipment available.
5. There should be strict enforcement of game rules and administrative regulations should be enforced to protect the health of the athlete. Coaches and school officials must support the game officials in their conduct of the athletic contests.
6. Coaches should know and have the ability to teach the proper fundamental skills of the sport. This recommendation includes all sports, not only football. The proper fundamentals of blocking and tackling should be emphasized to help reduce head and neck injuries in football. **Keep the head out of blocking and tackling.**
7. There should be continued safety research in athletics (rules, facilities, equipment).
8. Strict enforcement of the rules of the game by both coaches and game officials will help reduce serious injuries.
9. When an athlete has experienced or shown signs of head trauma (loss of consciousness, visual disturbance, headache, inability to walk correctly, obvious disorientation, memory loss) he/she should receive immediate medical attention and should not be allowed to return to practice or game without permission from the proper medical authorities. It is important for a physician to observe the head injured athlete for several days following

the injury. Coaches should encourage athletes to let them know if they have any of the above mentioned symptoms (that can't be seen by others, such as headaches) and why it is important.

10. Athletes and their parents should be warned of the risks of injuries.
11. Coaches should not be hired if they do not have the training and experience needed to teach the skills of the sport and to properly train and develop the athletes for competition.
12. Weight loss in wrestling to make weight for a match can be dangerous and cause serious injury or death. Coaches should be aware of safety precautions and rules associated with this practice.

**\*\*\*SPECIAL NOTE\*\*\***

All of the information has been thoroughly checked and the data cleaned. Some of the numbers in Tables I - XXIV have been changed due to this process. All of the data in this report now meet the stated definition of injury for high school and college sports. It is important to note that information is constantly being updated due to the fact that catastrophic injury information may not always reach the center in time to be included in the current final report. The report includes data that is reported to the NCCSIR by the NCAA, the NFHS, online reports, colleagues, coaches, and athletic trainers. There may be additional catastrophic injuries that are not reported to the Center.

**References**

1. TATOR CH, EDMONDS VE: National Survey of Spinal Injuries in Hockey Players, Canada Medical Association 1984; 130: 875-880.

## **CASE STUDIES**

### **FOOTBALL**

**High school and college case studies in football are not duplicated for this report. They are included in the football reports on the www site – [www.unc.edu/depts/nccsi](http://www.unc.edu/depts/nccsi)**

### **. HIGH SCHOOL**

#### **CROSS COUNTRY**

A 14 year-old high school cross country collapsed and died during a race (3 mile race). Cause of death was myocarditis. She passed a physical exam allowing her to compete in high school sports.

A male high school cross country runner collapsed from the heat during a cross country race – three miles. The heat index was 98 degrees during the race. He collapsed in the yard of a nurse, who iced him down and saved his life. The athlete has recovered. A number of schools are now placing monitors along the race route as a safety precaution. This is an excellent idea.

#### **SOCCER**

A 14 year-old, male, high school soccer player collapsed in the locker room after practice on November 13, 2007, and later died. Cause of death was heart related. The athlete had a heart valve replacement at age three. He was cleared to play by a physician.

A 15 year-old, male, high school soccer player collapsed during practice and later died. He collapsed on 11/30/07 and died on 12/1/07. Cause of death was heart related (hypertrophic cardiomyopathy).

A female high school soccer player received a serious brain injury while contesting a head ball. She and her opponent hit head to head with the opponents forehead hitting the athlete's right temple. Symptoms did not develop for several hours when she had a bad headache. She had a blood clot on the brain, had surgery, and recovered. She expects to play soccer next season.

#### **FIELD HOCKEY**

A 14 year-old female, high school field hockey player collapsed during a practice on 11/1/07 and died on 11/2/07. An AED was used by EMT's. Cause of death was believed to be heart related.

## **ICE HOCKEY**

### **HIGH SCHOOL**

NONE

## **SWIMMING**

### **COLLEGE**

A female college swimmer collapsed while jogging in August 2007. She died later at the hospital. Cause of death was aortic dissection.

A 26 year-old male college swimmer felt chest pains after practice on January 11, 2008. He later died in his apartment. Cause of death was believed to be heart related.

## **BASKETBALL**

### **HIGH SCHOOL**

A 16 year-old male high school basketball player died on 1/2/08 after collapsing during the first quarter of a game. He died at the hospital. Death was heart related.

A 17 year-old male basketball player collapsed during practice and later died. Cause of death was hypertrophic cardiomyopathy.

A 17 year-old male high school basketball player collapsed during a scrimmage and later died. Cause of death was heart related – a tear in the superior vena cava.

A 13 year-old female middle school student collapsed during practice. The coach tried to revive her with an AED, but she never regained consciousness.

A 13 year-old female middle school basketball player collapsed and died during the last minute of a game. An AED was used to get her heart beating again, but she died at the hospital 30 minutes later.

A 17 year-old, female high school basketball player collapsed during a play-off game and later died at the hospital. Cause of death was hypertrophic cardiomyopathy. An AED and CPR were used, but could not revive her.

### **COLLEGE**

The results of an autopsy revealed that a male college basketball player died of an enlarged heart (hypertrophic cardiomyopathy) after collapsing at practice.

## WRESTLING

### **HIGH SCHOOL**

A 16 year-old male wrestler collapsed after completing a morning run. He was participating in a June 2008 summer wrestling camp run by his high school coach. Death was heart related.

## LACROSSE

### **HIGH SCHOOL**

A 16 year-old male lacrosse player was hit in the chest by a shot. His heart stopped, but within seconds CPR and use of an AED his heart began beating. The AED was on the sideline. He has recovered.

A male lacrosse player was hit in the chest by a shot during a game on April 25, 2008. His heart stopped beating but was started again with the help of CPR and an AED. The athlete has recovered.

Both of the above lacrosse cases would have ended in death without the availability and use of an AED.

A male lacrosse player hit an opponent with his head in a down position and fractured cervical vertebra #7. He had two surgeries and wore a neck brace for five weeks. He has recovered. Hitting with the head in lacrosse is against the rules and is dangerous. This athlete was lucky he was not paralyzed.

## BASEBALL

### **HIGH SCHOOL**

In May 2008 a JV high school baseball player was pitching batting practice when struck in the head by a batted ball. He was pitching from behind an L-screen, but was not fully behind the screen. He had a subdural hematoma, but recovered.

A male high school baseball player was pitching batting practice when struck in the head by a batted ball. He was struck about two inches above the left eye. He was normally a catcher. He failed to get behind the L-screen after the pitch. He had a subdural hematoma, had surgery, and recovered.

## TRACK

### **HIGH SCHOOL**

An 18 year-old male high school pole vaulter died during a practice vault in an indoor facility. He did not make it over the bar and fell backward onto the runway. He died of a brain injury. The accident took place in April 2008. The athlete was not wearing a helmet.

A 17 year-old male high school track athlete collapsed at the finish of a 400 meter run. He had an undiagnosed heart defect. An AED was used, but was not successful.

**2007 Update**

A female high school shot putter was hit in the head with a discus while retrieving her warm-up toss. She was struck in the head by the three pound discus. She had a severe brain injury, surgery, and was in the hospital for 12 days. A year after the injury she has recovered and is back playing sports.

**VOLLEYBALL**

**HIGH SCHOOL**

NONE

**GOLF**

**HIGH SCHOOL**

NONE

**SOFTBALL**

**HIGH SCHOOL (2007 UPDATE)**

A female high school softball player was hit in the face with a batted ball while pitching. She had a fractured cheekbone, a fractured nose, and a lacerated artery. She had three transfusions while in the hospital and has recovered from her injuries. She started playing again a month later.

**TENNIS**

**HIGH SCHOOL AND COLLEGE**

NONE

**WATER POLO**

**HIGH SCHOOL AND COLLEGE**

NONE

**GYMNASTICS**

**HIGH SCHOOL AND COLLEGE**

NONE

**ROWING**

**HIGH SCHOOL AND COLLEGE**

NONE

**EQUESTRIAN**

**HIGH SCHOOL AND COLLEGE**

NONE

### **Special Section on Cheerleading**

The Consumer Product Safety Commission (CPSC) reported an estimated 4,954 hospital emergency room visits in 1980 caused by cheerleading injuries. By 1986 the number had increased to 6,911, in 1994 the number increased to approximately 16,000, in 1999 the number increased to 21,906, and in 2004 the number increased to 28,414. In 2006 the numbers were down to 25,966, and in 2007 were up slightly to 26,786. An important part of the CPSC cheerleading data is that in 2006 head and neck injuries accounted for 16.1% of the total cheerleading injuries, and in 2007, 15.1% of the injuries. Facial injuries accounted for 8.9% and 7.6% respectively. In 2006 head injuries were associated with 1,070 concussions, 200 contusions, 15 fractures, and 1,157 internal injuries. In 2007 head injuries were associated with 783 concussions, 308 contusions, 69 lacerations, and 1,122 internal injuries. The number of concussions was down in 2007, which is a good sign. Neck injuries in 2006 accounted for 79 contusions, 60 fractures, and 1,325 sprains/strains. In 2007 neck injuries were associated with 303 contusions, 5 fractures, and 1,281 sprains/strains. It is also important to note that in both years approximately 98% of the cheerleading injuries in the CPSC data were treated and released. Even though the numbers for being treated and released were high for both years, there were still 221 athletes hospitalized, 217 treated and transferred to another hospital, and 64 held for observation. The reduction of serious head and neck injuries in 2007 is a good sign, and hopefully this trend will continue. The goal for cheerleading coaches and organizations should be to eliminate head and neck injuries. One catastrophic injury is too many. Granted, the number of cheerleaders has also increased dramatically during this time frame. It is important to stress that catastrophic injuries have also been a part of cheerleading during the last 26 years and coaches and administrators should be aware of the situation.

The National Center for Catastrophic Sports Injury Research has been collecting cheerleading catastrophic injury data during the past twenty-six years, 1982-83 – 2007-2008 (see Tables 5 and 6). There were three high school cheerleading catastrophic injuries during the 2007-2008 school year. One of the injuries involved a female cheerleader being hit in the face/eye by

the flyer. She suffered a blowout fracture of the eye, had two surgeries, and still suffers from double vision. The second female cheerleader was a flyer doing a double down stunt hitting headfirst to the floor. She could not walk for three months, missed months of school, and continues to suffer from pain. The third high school female cheerleader was a flyer and also landed head first to the floor. The floor did have wrestling mats. She had a neck injury and a severe concussion. She suffers chronic headaches, post concussion migraines, and neck pain. She will have to be re-evaluated in six months. College cheerleading was involved in one accident during 2007-2008. The female cheerleader was injured during a basketball game when she landed on her head to the floor. She was evaluated at the hospital and will recover from the injury.

An indirect injury to a high school cheerleader took place on April 24, 2008. She went into cardiac arrest and was saved by CPR from her coach, and the use of an AED by emergency personnel.

## **2005 UPDATE**

On September 12, 2005, a male high school cheerleader was injured while doing a back handspring. He fractured a cervical vertebra, had to wear a neck brace, and recovered from the injury.

Following is a sample review of the data:

1. In the early 1980's a female college cheerleader fractured her skull after falling from a human pyramid. She recovered and returned to cheerleading after several weeks in the hospital.
2. In 1983 two female college cheerleaders received concussions within a period of five days in the same gymnasium. One struck her head on the floor after falling from a pyramid and the second cheerleader struck her head on the floor after falling backward from the shoulders of a male partner.

3. In the summer of 1984 a female high school cheerleader was injured at practice when she fell from a pyramid. She was partially paralyzed.
4. A male college cheerleader was injured in a tumbling accident during a basketball game in December 1983. He fractured and dislocated several cervical vertebrae and was paralyzed. He received his injuries after diving over a mini-trampoline and several cheerleaders. The stunt is called a dive into a forward roll. He has made progress and can now walk unaided for several blocks and is able to feed himself.
5. In 1985 a female high school cheerleader was paralyzed from the chest down after attempting a back flip off the back of another cheerleader.
6. In 1985 a female college cheerleader fractured her skull after a fall from the top of a pyramid striking her head on the gym floor. She was in critical condition for a period of time but has made progress and is back in school. She is now involved in occupational therapy.
7. A male college cheerleader was paralyzed after a fall in practice. He was attempting a front flip from a mini-trampoline. He dislocated several cervical vertebrae and is now quadriplegic.
8. In 1986 a female college cheerleader fell from a pyramid and was knocked unconscious after striking the floor. Her status was unknown at the time of this writing.
9. In 1986 a college female cheerleader died from injuries suffered in a cheerleading accident. She suffered multiple skull fractures and massive brain damage after falling from the top of a pyramid type stunt and striking her head on the gym floor.
10. In 1987 a 17-year-old high school cheerleader fell from a pyramid. She was tossed into the air by two other cheerleaders and was supposed to flip backwards and land on the shoulders of two other girls. Her spinal cord was not severed but she is paralyzed from the waist down.
11. During the 1987-1988 school year a female cheerleader suffered a fractured collarbone, a damaged eardrum and a basal skull fracture. She was practicing a pyramid and was six

feet off the gym floor with no spotters. She has suffered partial hearing loss and has to wear special glasses for reading.

12. In January 1988 a female cheerleader fell from a pyramid and landed on her face and shoulder. She suffered a fractured collarbone and head injuries. She was in a light coma in the hospital but complete recovery is expected.
13. In January 1989 a high school cheerleader fractured a cervical vertebra after falling from a mount in practice. She will recover with no permanent disability.
14. On July 11, 1989 a 16-year-old high school cheerleader fractured a cervical vertebra and is quadriplegic. She slipped while doing a series of back flips on damp grass.
15. On March 10, 1990 a female high school cheerleader was thrown into the air by two other cheerleaders. She fell to the floor onto her neck and was in the hospital for one week. The routine was called a basket toss. She has recovered and is back in school.
16. On March 1, 1990 a 21-year-old male college cheerleader was injured at practice. In attempting to do a back flip he hit his head against a wall. He was taken to the hospital by ambulance. He has since recovered and the injuries were not serious.
17. In June of 1991 a 15-year-old cheerleader suffered injuries to the head. She was struck in the head by her falling partner and also after striking the ground. The injury took place in a cheerleading camp. The cheerleader was taken to the hospital but her condition is not known at this time.
18. A middle school cheerleader was injured in October 1991 and died the next week. She fell from a double level cheerleading stance during practice. She hit her head on the gym floor.
19. A 20-year-old college cheerleader suffered a head injury while practicing a cheerleading stunt in which she was thrown into the air but was not caught by her teammates. She landed on the gym floor. She was in critical condition but has been upgraded to serious and is expected to recover.

20. In May of 1992 a college cheerleader was doing a tumbling sequence when she landed on her back and fractured T-12. The practice was not supervised. There was a complete recovery.
21. A high school cheerleader was injured during a basketball game doing a back handspring tuck. She hit her head on the floor. She had surgery to remove a blood clot. Her condition is not known at this time.
22. A high school cheerleader was tossed in the air during a routine, was not caught, and fell hitting her face on the basketball floor. She remained motionless for approximately 30 minutes. She is expected to recover. The accident happened in December 1993.
23. A high school cheerleader fell and hit her head on the basketball floor while being lifted by the feet by two other cheerleaders. She was taken to the hospital for observation and is expected to recover. The accident happened in December 1993.
24. A college cheerleader was doing a tumbling run when he lost control and fell on his head. He fractured a cervical vertebra and is expected to recover. The accident happened in August 1994.
25. A college cheerleader was injured in a cheerleading competition in April 1994. She struck another cheerleader while doing a backflip and fell to the floor. She suffered a fractured cervical vertebra and is expected to recover.
26. A female college cheerleader received a fractured skull during warm-ups for a performance of stunts for a Christmas parade. She was injured in a four man back tuck basket toss. She landed on her head. There was no permanent disability, but she was in rehabilitation for memory. The injury occurred in November 1994.
27. A high school cheerleader was kicked in the face by a teammate who was falling from the top of a pyramid. The injured cheerleader suffered convulsions and was transported to the hospital. She was in stable condition and was expected to recover. The injury occurred in January 1995.

28. A high school cheerleader received a closed head injury in March 1995 during a basket toss stunt. She landed on a hard rubberized basketball court. There was no permanent disability.
29. A college cheerleader was paralyzed in April 1995 after being injured while performing a double flip during a basket toss. At the present time she is quadriplegic.
30. A high school cheerleader was injured during a stunt when a fellow cheerleader fell on her head. She has had permanent medical problems since the accident. This was an update from November 1993.
31. In 1997, a high school cheerleader suffered a 15-foot fall. She had spinal cord trauma and is paralyzed. No other information was available.
32. A college cheerleader was injured in 1997 during a tumbling routine and is now quadriplegic. She was attempting a back handspring into a single back tuck during practice and landed on her head.
33. In 1997, two cheerleaders collapsed and died - one during a game and one in tryouts. Cause of death was heart related.
34. A high school junior cheerleader was doing a warm-up for a stunt in a state cheerleading competition. The stunt involved the cheerleader doing a flip off the hands of a teammate into the arms of several teammates. The teammates failed to catch her and she landed on her back. She suffered a fractured elbow, a concussion, and a back injury that later required spinal fusion. She was not able to return to school and had to be tutored her final high school years. (This case was a 1992 update)
35. On September 11, 1998 a 17-year-old high school cheerleader was cheering at a football game. She attempted a back flip, slipped on wet artificial turf, and landed on her head. She had spinal cord shock and temporary paralysis. Recovery was going to take approximately six months.

36. A 17-year-old high school cheerleader was injured in practice while practicing a pyramid formation. She fell and bruised her spinal column. She has recovered from the injury and is back cheering.
37. A 14-year-old high school cheerleader was injured while doing a dance routine at practice. She slipped on some water, fell and hit her head, and was taken to the hospital. She was in intensive care but has recovered.
38. A middle school cheerleader fell during a stunt while practicing with her squad before a game. She injured the ligaments around her spinal cord and was placed in a halo brace. She is prohibited from participating in contact sports, but will recover.
39. While cheerleading at a basketball game the athlete collided with a player chasing a loose ball. She received a fractured skull and had a blood clot removed. Full recovery was expected.
40. Squad was practicing a new stunt and the athlete was up in an extension of her partner's arm when she fell and landed on her head. She had a fractured skull and was on a ventilator for 12 hours. Full recovery was expected.
41. Athlete was on the third level of a pyramid during practice and fell on her head. She had a fractured skull and full recovery was expected.
42. During the 2001-2002 academic year three high school cheerleaders and one college cheerleader had catastrophic injuries. All four involved fractured skulls.
43. In August of 2005 a 14 year-old female high school cheerleader died after being thrown into the air and landing chest down in the arms of her teammates. She died of a lacerated spleen caused by blunt abdominal trauma.
44. A 16 year-old high school female cheerleader suffered spinal shock on 9/24/05 after fall onto her back from the shoulders of a teammate. She had a full recovery.
45. A 14 year old high school female cheerleader fell on her head during a cheerleading stunt on October 27, 2005, and was taken to the hospital. No other information was available.

46. A college female cheerleader fractured a cervical vertebra and suffered a concussion on March 5, 2006, performing a stunt during a basketball game. She fell 15 feet onto her head. A recovery was expected.
47. A male 18 year-old high school cheerleader landed on his neck after performing a standing back tuck on September 12, 2005. It was during a practice session. The injury was a fractured cervical vertebra and he is recovering. He was 6' 2" tall and weighed 215 pounds.
48. A 14 year-old female high school cheerleader suffered a fractured skull on November 15, 2005, when her teammates did not catch her during a stunt. She has recovered.
49. A female high school cheerleader fractured her skull on January 2, 2006, during a basket toss in the school cafeteria. She landed on her head and was taken to the hospital. She has recovered.
50. A 14 year-old female high school cheerleader collapsed and died during a cheerleading practice. She collapsed after being the flyer on a basket toss. Cause of death was cardiac arrest. A defibrillator was used after the accident.
51. In 2002 a 16 year-old male high school cheerleader was injured during a practice session. He fractured a cervical vertebra and is quadriplegic.
52. In January 2007 a 15 year-old high school cheerleader was performing a double front flip into a cushioned landing when she took an odd bounce and landed on her neck. She had damage to cervical vertebrae 6-7 and had a five hour surgery. She has a permanent titanium plate and screws along her spine. She has recovered, but will not participate in cheering again.
53. An 18 year-old college cheerleader fractured her neck in two places when she fell head first from a height of about 15 feet. She was a flyer during practice. She had a halo brace bolted to her skull for two months. She has recovered, but will not cheer again and her movements are highly restricted.

54. In March of 2007 a college cheerleader fractured her neck, had a concussion, and bruised a lung after falling 15 feet from a pyramid during a basketball game. She lost her balance and fell to the floor.

Cheerleading has changed dramatically in the past twenty-six years and now has two distinctive purposes; 1) of a service-oriented leader of Cheer on the sideline; and 2) as a highly skilled competing athlete. A number of schools, both high schools and colleges, across the country have limited the types of stunts that can be attempted by their cheerleaders. Rules and safety guidelines now apply to both practice and competition. As already stated in this report, high school and college cheerleaders account for over one-half of the catastrophic injuries to female athletes. Inexperienced and untrained coaches should not attempt to teach stunts with a higher level of difficulty than their team is capable of achieving or they have the knowledge and ability to teach.

The basic question that has to be asked is what is the role of the cheerleader? Approximately 20-25 states have a state championship for competitive cheer and it is not clear how many states consider cheerleading a sport. The 2007-2008 high school participation survey for competitive spirit squads shows 111,307 females. There were also 2,673 male cheerleaders. The National Federation of State High School Associations had a news release on May 21, 2009 that stated there are approximately 400,000 individuals participating in high school cheerleading. The release stated that the 400,000 included freshman, junior varsity, and varsity levels. The release did not distinguish between the number of males and females. There are 18,922 high schools in the 51 member associations, and the new participation number translates to an average of 21 cheerleaders per school. Past participation numbers only included competitive cheer groups (113,980 male and females in 2007-2008). College participation numbers are hard to find since cheerleading is not an NCAA sport.

The catastrophic incidence rate per 100,000 cheerleading participants would be reduced with the new participation numbers. The three injuries in 2007-2008 would have a competitive cheer incidence rate of 2.63 per 100,000 participants, and with the new participation numbers the

cheer incidence rate would be 0.75 per 100,000 participants. It will be important for future injury data collection to know whether it was a competitive cheer injury or regular cheer injury. It is also important to mention that all other high school female sports were associated with three catastrophic injuries in 2007-2008. The other female sports with catastrophic injuries had 2,384,836 participants, and a catastrophic injury incidence rate of 0.13 per 100,000 participants. The most important number is that high school cheerleading accounted for 65.2% of all catastrophic injuries to high school female athletes. This figure emphasizes the importance of safety regulations and rules for cheerleading. Progress has been slow, but there has been an increased emphasis on cheerleading safety. Continued data collection on all types of cheerleading injuries will hopefully show that these safety measures are working to reduce injuries.

Is cheerleading an activity that leads the spectators in cheers or is it a sport? If the answer is to entertain the crowd and to be in competition with other cheerleading squads, then there must be safety guidelines initiated. The authors of this research question why it is called cheerleading, when competitive cheer has nothing to do with leading the crowds at athletic events in cheering for the athletic teams on the playing field. Following are a list of sample guidelines that may help prevent cheerleading injuries:

1. Cheerleaders should have medical examinations before they are allowed to participate. Included would be a complete medical history.
2. Cheerleaders should be trained by a qualified coach with training in gymnastics and **partner stunting**. This person should also be trained in the proper methods for spotting and other safety factors.
3. Cheerleaders should be exposed to proper conditioning programs and trained in proper spotting techniques.
4. Cheerleaders should receive proper training before attempting gymnastic and partner type stunts and should not attempt stunts they are not capable of completing. A qualification system demonstrating mastery of stunts is recommended.

5. Coaches should supervise all practice sessions in a safe facility.
6. Mini-trampolines and flips or falls off of pyramids and shoulders should be prohibited.
7. Pyramids over two high should not be performed. Two high pyramids should not be performed without mats and other safety precautions.
8. If it is not possible to have a physician or certified athletic trainer at games and practice sessions, emergency procedures must be provided. The emergency procedure should be in writing and available to all staff and athletes.
9. There should be continued research concerning safety in cheerleading.
10. When a cheerleader has experienced or shown signs of head trauma (loss of consciousness, visual disturbances, headache, inability to walk correctly, obvious disorientation, memory loss) she/he should receive immediate medical attention and should not be allowed to practice or cheer without permission from a physician.
11. Cheerleading coaches should have some type of safety certification. The American Association of Cheerleading Coaches and Advisors offers this certification.
12. The NFHS should make cheerleading a sport, which will place cheerleading under the same restrictions and safety rules as all other high school sports. The NCAA should follow this same recommendation.

According to the National Federation of State High School Associations, a primary purpose of sideline spirit groups (dance, pom, drill or cheer) is to serve as support groups for the interscholastic athletic programs within the school. A primary purpose for competitive spirit groups is to represent the school in organized competition. In January of 1993, 18 rules revisions were adopted for spirit groups. One of the major rules prohibits tumbling over, under, or through anything (people or equipment). All of the other rules were adopted to enhance the safety of the participants. Today, emphasis is placed not only on the stunting athlete, but also on the base and the spotter. Proper conditioning and attentiveness will help minimize the risk involved in a competition. Information concerning these new rules and updates are available from the

National Federation of State High School Associations in Indianapolis, Indiana. The contact person is Susan Loomis.

The NFHS Spirit Rules Book (2009-2010) has just been published and is available from the NFHS. The new book lists four rule changes, and includes a section called Points of Emphasis. The Points of Emphasis covers coach's responsibility, event security, and a section on spring floors. The book also illustrates what stunts are legal and what stunts are illegal. All coaches should be familiar with the NFHS Rules Book, should read it, and should always have it available for a reference.

On July 1, 2006, the Missouri State High School Activities Association no longer sanctioned cheerleaders to take part in regional or state competitions. The association will maintain jurisdiction over sideline cheerleading at school athletic events. Squads that want to compete must do so as a club. In the fall of 2007 the South Dakota High School Activities Association will sanction competitive cheerleading and dance, and compete for state championships. The decision was made from a student interest survey, and female four top sports were cheer, dance, softball, and soccer.

In July 2006 the National Collegiate Athletic Association (NCAA) and Varsity Brands have formed an alliance to enhance cheerleading safety at NCAA institutions by creating the College Cheerleading Safety Initiative. An important part of this program is the safety program developed by the American Association of Cheerleading Coaches and Administrators (AACCA). The latest addition of the AACCA Cheerleading Safety Manual was published in 2006 and is very informative for college coaches. All college coaches should have a copy of this safety manual and be familiar with its contents.

In 2005 the NCAA Insurance program stated that 25% of money spent on student athlete injuries resulted from cheerleading. The rate of cheerleaders to football players is 12 to 100. It is the opinion of the authors that following cheerleading rules and safety manual guidelines that are written by cheerleading experts is an excellent way to help prevent cheerleading injuries. The new restrictions can be found on the AACCA web site [www.aacca.org](http://www.aacca.org). The web site also

has safety measures for high school cheerleading and other safety information. There is also a publication on the website called “A Parents Guide to Cheerleading Safety” which offers the five top questions parents should be asking when their child joins a school cheerleading squad.

In 2008 the National Center for Catastrophic Sports Injury Research (NCCSIR) was contacted by Ms. Kimberly Archie, Director of the National Cheer Safety Foundation. The National Cheer Safety Foundation was created by parents for parents, and is interested in cheer safety and the collection of cheerleading injury data. Cheer injuries can be reported to [www.cheerinjuryreport.com](http://www.cheerinjuryreport.com). Krista Parks, a college cheerleader who had a serious injury while cheering, is the National Spokesperson.

The Foundation was interested in collecting cheerleading injury data from across the United States and was interested in collaborating with the NCCSIR. The NCCSIR was interested in working with the Foundation since it is always an asset to get as much injury data as possible for all sports from all sources. Ms. Archie sent me an initial list of 86 cheerleading injuries, of which NCCSIR had only a small number. After going through the list, a decision was made to include 30 of the injuries and to combine them with the NCCSIR data. A recommendation was also made to the Foundation as to the kinds of data that should be collected for catastrophic cheerleading injuries in the future. It is expected that future data will meet all of the requirements. As an example, the NCCSIR did not include concussion injuries unless they were severe brain injuries and created ongoing medical problems. The Center also did not include injuries that could not be verified. Catastrophic injuries as defined by the NCCSIR can be found in the introduction to this report.

The authors of this report thought it was important to mention that there are some cheerleading organizations that continue to make excuses for the number of injuries

(catastrophic and others) that are associated with the sport. What all cheerleading organizations should do is realize that cheerleading has had injury related problems, and strict safety measures should be adopted to remedy the situation. An important safety measure is the continuation of injury data collection systems that point out the problem areas and emphasize the importance of rule changes, safety equipment, teaching techniques, medical care and coverage at practice and contests, and a written emergency plan available to all personnel and athletes. An excellent sample emergency plan can be found at the National Cheer Foundation web site – click on emergency plan. The National Center for Catastrophic Sports Injury Research has played a major role in cheerleading safety since we collected the first catastrophic cheerleading injury data in 1982-83.

TABLE 5  
HIGH SCHOOL CHERLEADING  
DIRECT CATASTROPHIC INJURIES  
1882-1983 - 2007-2008

YEAR	FATALITY	NON-FATAL	SERIOUS	TOTAL
1982-1983	0	0	0	0
1983-1984	0	0	0	0
1984-1985	0	2	0	2
1985-1986	0	1	0	1
1986-1987	0	0	1	1
1987-1988	0	2	1	3
1988-1989	0	0	1	1
1989-1990	0	1	1	2
1990-1991	0	1	1	2
1991-1992	1	1	0	2
1992-1993	0	0	1	1
1993-1994	0	0	2	2
1994-1995	0	2	2	4
1995-1996	0	0	1	1
1996-1997	0	1	1	2
1997-1998	0	1	0	1
1998-1999	0	0	5	5
1999-2000	0	0	4	4
2000-2001	0	1	1	2
2001-2002	0	4	3	7
2002-2003	0	2	2	4
2003-2004	0	3	3	6
2004-2005	0	0	4	4
2005-2006	1	0	10	11
2006-2007	0	0	2	2
2007-2008	0	3	0	3
TOTAL	2	25	46	73

TABLE 6  
 COLLEGE CHEERLEADING  
 DIRECT CATASTROPHIC INJURIES  
 1982-1983 – 2007-2008

YEAR	FATALITY	NON-FATAL	SERIOUS	TOTAL
1982-1983	0	1	1	2
1983-1984	0	1	2	3
1984-1985	0	1	0	1
1985-1986	1	1	0	2
1986-1987	0	0	1	1
1987-1988	0	0	0	0
1988-1989	0	0	0	0
1989-1990	0	0	1	1
1990-1991	0	0	0	0
1991-1992	0	0	1	1
1992-1993	0	0	0	0
1993-1994	0	0	2	2
1994-1995	0	1	1	2
1995-1996	0	0	0	0
1996-1997	0	1	1	2
1997-1998	0	0	1	1
1998-1999	0	1	0	1
1999-2000	0	0	1	1
2000-2001	0	1	0	1
2001-2002	0	1	2	3
2002-2003	0	0	0	0
2003-2004	0	2	0	2
2004-2005	0	0	0	0
2005-2006	0	0	1	1
2006-2007	0	0	3	3
2007-2008	0	0	1	1
TOTAL	1	11	19	31

Table 7 illustrates high school female catastrophic injuries for the past 26 years – including cheerleading. High school female sports accounted for 112 catastrophic injuries during this time period, and 73 of those injuries were to cheerleaders. Of the 112 injuries, 4 resulted in death, 44 with permanent disability, and 64 were serious injuries with recovery. The 73 cheerleading injuries accounted for two deaths, 25 permanent disability injuries, and 46 serious injuries with recovery. High school cheerleaders accounted for 65.2% of all female sports catastrophic injuries. The three charts at the end of the report illustrate the number of female cheerleading injuries versus all other female sports injuries at the high school level.

**TABLE 7**  
**HIGH SCHOOL FEMALE DIRECT CATASTROPHIC INJURIES**  
**1982-83 – 2007-08**

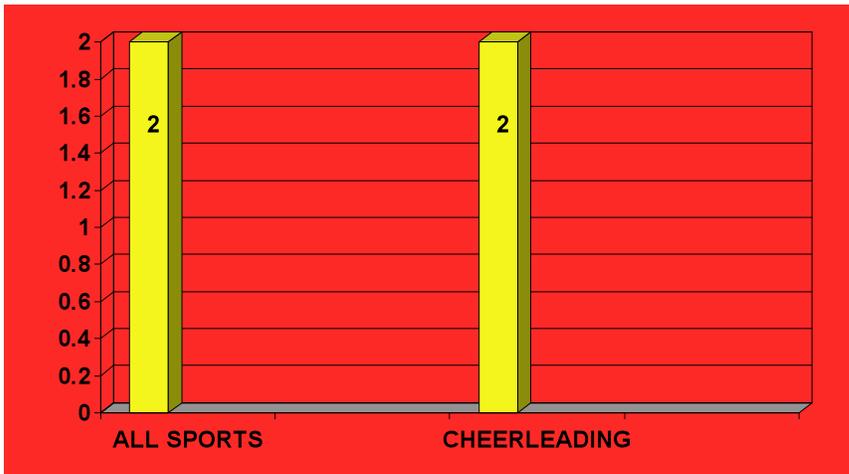
<b>SPORT</b>	<b>FATALITY</b>	<b>NON-FATAL</b>	<b>SERIOUS</b>	<b>TOTAL</b>
Cheerleading*	2	25	46	73
Gymnastics	0	6	3	9
Track	1	1	6	8
Swimming	0	4	1	5
Basketball	0	1	3	4
Ice Hockey	0	0	2	2
Field Hockey	0	3	0	3
Softball	1	2	1	4
Lacrosse	0	0	1	1
Soccer	0	1	1	2
Volleyball	0	1	0	1
<b>TOTAL</b>	<b>4</b>	<b>44</b>	<b>64</b>	<b>112</b>

Table 8 illustrates college female catastrophic injuries for all sports for the past 26 years. There were a total of 44 catastrophic injuries which included three deaths, 18 permanent disability injuries, and 23 serious injuries with recovery. Cheerleading accounted for 31 catastrophic injuries which included one death, 11 permanent disability injuries, and 19 serious injuries with recovery. College cheerleading was associated with 70.5% of all college female sports catastrophic injuries for the 26 years of data collection.

**TABLE 8**  
**COLLEGE FEMALE DIRECT CATASTROPHIC INJURIES**  
**1982-1983 – 2007-2008**

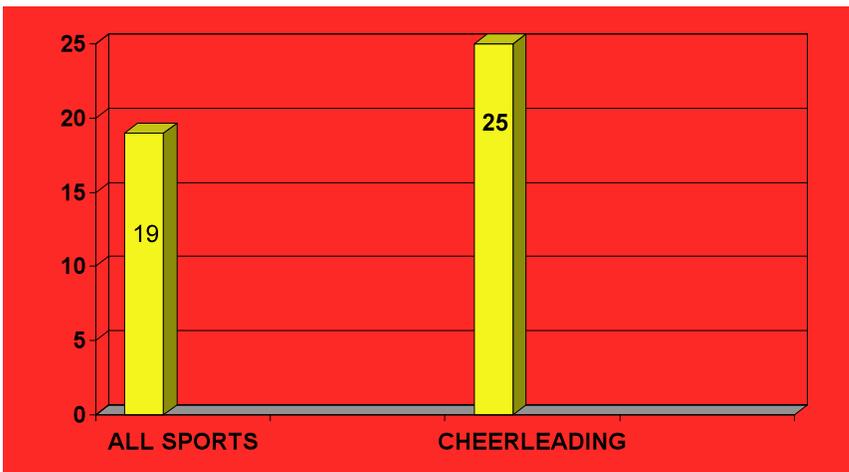
<b>SPORT</b>	<b>FATALITY</b>	<b>NON-FATAL</b>	<b>SERIOUS</b>	<b>TOTAL</b>
Cheerleading*	1	11	19	31
Field hockey	0	1	2	3
Lacrosse	0	2	0	2
Gymnastics	0	2	0	2
Equestrian	1	0	0	1
Soccer	0	1	0	1
Ice Hockey	0	0	1	1
Skiing	1	0	0	1
Track (Pole Vault)	0	1	0	1
Softball	0	0	1	1
<b>TOTAL</b>	<b>3</b>	<b>18</b>	<b>23</b>	<b>44</b>

## HS FEMALE DEATHS 1982-83 – 2006-07



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## HS FEMALE DISABILITY 1982-83 – 2006-07



# HS FEMALE SERIOUS 1982-83 – 2006-07

