National Center for Catastrophic Sport Injury Research

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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. 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 a 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 which resulted directly from participation in the skills of the sport.

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

Data Collection

Data were compiled with the assistance of coaches, athletic directors, executive officers of state and national athletic organizations, a national newspaper clipping service and professional associates of the researchers. Data collection would not have been possible without the support of the National Collegiate Athletic Association, the National Federation of State High School Associations and the American Football Coaches Association. 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 contacting the physician involved in each case and for collecting the medical data. Dr. Cantu is also the Past-President of the American College of Sports Medicine.

Summary

Fall Sports (Tables I - VIII)

As indicated in Tables I through VIII, football is associated with the greatest number of catastrophic injuries. For the 2000 football season there was a total of 24 high school direct catastrophic injuries, which is an increase of three from 1999, but a decrease when compared to the 1997 and 1998 seasons. College football was associated with five direct catastrophic injuries in 2000, which is an increase of two when compared to 1999 and a decrease when compared to the 1998 data.

In 1990 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, with a slight rise in 1995 to four. These numbers are very low when one considers that there were 36 football direct fatalities in 1968.

In addition to the direct fatalities in 2000 there were also twelve indirect fatalities. Ten of the indirect fatalities were at the high school level and two were at the college level. Eight of the high school indirect fatalities were heart related and two were heat related. Both of the college indirect fatalities were heat related.

In addition to the fatalities there were eight permanent paralysis cervical spine injuries in 2000. This number is low when compared to the 25 to 30 cases every year in the early 1970's. Six of the injuries were at the high school level and two at the college. Football in 2000 was also associated with

six cerebral injuries that resulted in permanent disability. All three of the injuries were at the high school level. Five of the injuries were at the high school level and one at the college level.

Serious football injuries with no permanent disability accounted for 12 injuries in 2000 - ten in high school and two in college. High school athletes were associated with four cervical spine fractures, three brain injuries with full recovery, and three cervical spine contusions. College athletes were associated with one cervical spine contusion and one brain injury with complete recovery.

This decrease in catastrophic football injuries 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 it's participants.

Cross country was not associated with any direct injuries in 2000. For the nineteen years indicated in Tables I through VIII, cross country was associated with one direct non-fatal injury and 12 indirect fatalities at the high school level and one indirect fatality at the college level. All thirteen of the indirect injuries were heart related fatalities. Autopsy reports revealed congenital heart disease in three of these cases.

Table I shows that high school soccer had no direct death in 2000 and a total of 14 catastrophic injuries for the past 19 seasons. The three direct catastrophic injuries in 1992 was the highest number in the past nineteen years. There were three high school soccer indirect fatalities in 2000. A male player died suddenly while playing, a female player also collapsed at practice and died, and a second female died from an aneurysm while participating. In 2000 college soccer was associated with one direct serious injury and no indirect injuries. There were also two non-school injuries in 1998 that should be mentioned again in the 2000 report. A young boy was paralyzed after being hit when the soccer goal tipped and struck him in the head. The second case involved a 22 year old soldier who was struck in the head by the soccer goal after attempting to move the goal with a group of players. Being struck by a soccer goal has been an on-going problem and precaution should be taken when they are being moved. In addition, concussion injuries as related to heading is a controversial area in soccer. tThere are helmet manufacturers that are now making soccer helmets to protect the participants from brain

injries 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, in 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. 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. The National Center will keep abreast of this controversial area.

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 shows 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. There were no direct or indirect field hockey injuries in 1998. The 1999 data show on 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 sick during a drill, and the college injury resulted in a fractured skull after being hit by a ball. There have been no indirect catastrophic injuries in field hockey.

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 2000.

In summary, high school fall sports in 2000 were associated with 24 direct catastrophic injuries. All 24 were associated with football. There were three fatalities, 11 involved permanent disability, and ten were considered serious. For the 19 year period 1982-2000, high school fall sports had 502 direct catastrophic injuries and 484, or 96.4%, were related to football participants. In 2000 high school fall sports were also associated with ten football indirect fatalities and three in soccer for a total of 13 indirect fatalities. For the period from 1982-2000 there was a total of 161 indirect fall high school catastrophic injuries. One hundred and sixty of the indirect injuries were fatalities and 122 were related to football. Seven of the indirect

fatalities involved females - five soccer players, one water polo player, and a cross-country athlete. Females were also associated with three direct catastrophic injuries and all three were in field hockey.

During the 2000 college fall sports season there was a total of six direct catastrophic injuries with five in football and one in soccer. For the nineteen years, 1982-2000, there was a total of 114 college direct fall sport catastrophic injuries, and 110 were associated with football. There were two indirect college fatality during the fall of 2000 and both were associated with football. From 1982 through the 2000 season there was a total of 33 college fall sport indirect catastrophic injuries. Twenty-seven were associated with football.

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 junior high school football players participating each year. As illustrated in Table II, the 19 year rate of direct injuries per 100,000 high school and junior high school football participants was 0.30 fatalities, 0.72 non-fatal injuries and 0.76 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 high, but are based on only seven years of data, and water polo has approximately 9,000 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 nineteen year period indicated in Table VI, for college football fatalities is less than one per 100,000 participants, but the rate increases to 1.89 per 100,000 for non-fatal injuries and 5.26 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 13 years of data, water polo has approximately 1,600 participants each year (Table VIII). There were three college female athletes receiving a direct or indirect catastrophic injury in a fall sport for this 19 year

period of time. Two were serious injuries in field hockey, and the other was an indirect death in soccer.

Incidence rates are based on 19 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 associated with only two direct catastrophic injuries in 2000-2001. One injury was related to gymnastics, and one to wrestling.

High school winter sports were also associated with three indirect injuries during the 2000-2001 school year (Table XI). All of the injuries were fatalities, and two were associated with basketball and one with swimming. All three of the fatalities were heart related, and the basketball players were males and the swimmer a female.

College winter sports, Tables XIII - XVI, had one direct basketball catastrophic injury during the 2000-2001 school year. During this same time period there was one indirect fatality in basketball and one in gymnastics. The basketball player was a male and the gymnast was a female. Both were heart related.

A summary of high school winter sports, 1982-2001, show a total of 94 direct catastrophic injuries (7 fatalities, 50 non-fatal, and 37 serious) and 105 indirect. Wrestling was associated with 43 or 45.7 percent of the direct injuries. Gymnastics was associated with 13, or 13.8%, of the direct injuries. Basketball was associated with 13 (13.8%), ice hockey was associated with 15 (16.0%), swimming was associated with nine (9.6%) direct injuries, and volleyball one (1.1%). Basketball accounted for the greatest number of indirect fatalities with 81, or 77.1%, of the winter total.

College winter sports from 1982-2001 were associated with a total of 23 direct catastrophic injuries. Gymnastics was associated with six (26.1%), ice hockey eight (34.8%), basketball six (26.1%), swimming one (4.3%), skiing one (4.3%) and wrestling one (4.3%). There were also 27 indirect injuries during this time period. Fifteen, or 55.6%, were associated with basketball,

three in wrestling, two in ice hockey, four 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 injury categories. High school wrestling has approximately 237,600 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 were associated with the highest injury rates for the winter sports. Gymnastics has averaged approximately 4,350 male and 26,400 female participants during the past nineteen years. Ice hockey averages 26,000 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 nineteen years, but the injury rate is 23.25 per 100,000 participants for non-fatal male injuriesand 6.94 per 100,000 for female non-fatal injuries. Participation figures show approximately 700 male and 1,500 female gymnastic participants each year.

College ice hockey was associated with four serious and four non-fatal injuries in nineteen years, but the injury rate is 5.50 per 100,000 participants for non-fatal and 4.13 for serious injuries. There are approximately 3,800 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 female serious injuries was 17.50 injuries per 100,000 participants and averaged approximately 300 participants per year for the past 19 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 2001. For this period of time there were 132,909 participants in college wrestling for an average of approximately 6,995 per year. The injury rate for this nineteen year period of time was 0.75 per 100,000 participants. College skiing has approximately 600 female participants each year and the one fatality in 1989-1990 produced a twelve year injury rate of 8.66 per 100,000 participants. This was the only skiing direct fatality since the study was initiated.

Injury rates for college indirect fatalities were high when compared to the high school rates. Basketball had an injury rate of 5.38 fatalities per 100,000 male participants, skiing 7.54, ice hockey 1.38 and swimming 2.56. The year 1997-98 is the first year where there were any indirect fatalities in wrestling. There were three deaths due to heat stroke associated with the wrestlers trying to make weight for a match. The indirect injury rate for wrestling was 2.26 per 100,000 participants.

The femail indirect injury rate for basketball was 0.44 per 100,000 participants, 1.16 per 100,000 for volleyball, and 3.47 for gymnastics.

Spring Sports (Tables XVII - XXIV)

High school spring sports were associated with two direct catastrophic injuries in 2001. Lacrosse was associated with one, and track one. There were four indirect fatalities in high school spring sports during the 2000-2001 school year.

College spring sports were associated with five direct any direct catastrophic injuries and no indirect injuries in 2001.

From 1983 through 2001, high school spring sports were associated with 93 direct catastrophic injuries (Table XVII). Twenty-nine were listed as fatalities, 30 as catastrophic non-fatal and 34 as serious. Baseball accounted for 38, track 47, lacrosse five, and softball three. Injury rates were less than one per 100,000 participants for each sport in all categories. There were four direct injuries to females in track and three in softball. There were also 41 indirect fatalities in high school spring sports during this time span (Table XIX). Twenty-six were related to track, nine in baseball, three in lacrosse and three in tennis. Four of the indirect fatalities involved female track athletes.

As illustrated in Table XXI, college spring sports were associated with 23 direct catastrophic injuries from 1983 to 2001. Seven of these injuries resulted in fatalities, eight were listed as non-fatal and eight were listed as serious. Baseball accounted for eight injuries, lacrosse six and track nine. Table XXIII shows that there were also six indirect fatalities in college spring sports during this time. Two indirect fatalities were associated with tennis, one was associated with track, two in baseball and one in lacrosse.

Injury rates for high school spring sports direct injuries were low as illustrated in Table XVIII. Baseball participation reveals approximately 400,000 players and 700 females each year, track 485,000 males and 387,000 females, and tennis 135,000 males and 135,000 females. The baseball figures do not include the 285,000 softball participants each year. Lacrosse has approximately 22,000 male and 13,000 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. Men's lacrosse had two fatalities, twoe non-fatal and two serious injuries and the injury rates were slightly higher than the other sports. Female lacrosse players were associated with one non-fatal injury and female track (pole vault) was associated with one non-fatal injury.. Participation figures reveal approximately 5,200 men and 3,400 women lacrosse players each year. The 1991 injury was to a female lacrosse player.

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 7,700 and women 7,500 participants 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 (1931-2001)

and the recommendations that were based on that data. Non-fatal football injuries, permanent disability, decreased to one for college football in 1995 and 1998. There was a dramatic reduction in high school football from 13 in 1990 and 1993 to four in 1991. There was an increase to eleven in 1995 and 1996 and 14 in 1997. The 2000 data show 11. 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 twelve serious injuries in football in 2000 - ten in high school and two in college. 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.

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 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 football!**

A major concern in football fatalities during the past seven years has been the number of indirect deaths due to heat stroke, both at the college and high school levels. During the past seven years there have been 20 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 – 1931-2001 there are recommendations for safety during football activity in hot weather.

It should be noted that since 1979, according to the Consumer Product Safety Commission, there have been at least 23 deaths and 38 serious injuries to children when movable soccer goals have fallen on them. The most recent cases involved a 10 year old male in May 1998. A soccer goal frame fell on his head while he was helping move it. The injury left him paralyzed. In August of 1999 a 22 year old soldier was killed when a soccer goal fell and hit him in the head. He and his friends were trying to move the metal 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.

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 fields 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 43 direct catastrophic injuries during the past nineteen years, but the injury rate per 100,000 participants is lower than both gymnastics and ice hockey. 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 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, but 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 and college athletes.

Men and women gymnastics were associated with high 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.

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 ends 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 a college injury for the past 18 years, but in 1997-98 a high school swimmer was paralyzed after diving into the shallow end of a pool while practicing a racing dive. It is a fact that since the swimming community was made aware of this fact, and along with rule changes and coaches awareness, the number of direct catastrophic injuries in swimming has been reduced. 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 Committee previously voted 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. This rule change is a refinement of a 1991-1992 rule change and took effect in the 1992-1993 season. The new 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. Between three and one-half and four feet, swimmers may start no higher than 18 inches above the water. Less than that, it's in the pool. In a news release dated November 30, 2001, the National Federation of State High School Associations made changes in starting platforms in high school swimming. Effective immediately for the 2001-02 swimming season, the Federation has eliminated the option for high schools to use 18 inch starting platforms in pools with water depth from 3 ½ to 4 feet. Swimmers must start from the deck or in the water at this water depth. While starting platforms still will be allowed for 2001-02 with a water depth of four feet or more, that could change for the 2002-03 season. Changes for the 2002-03 season will be discussed at a meeting in April of 2002. 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. 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.

High school spring sports have been associated with low incidence rates during the past nineteen years, but baseball was associated with 38 direct catastrophic injuries and track 47. A majority of the baseball injuries have been caused by the head first slide or by being struck with a thrown or batted ball. The 2001 data show one college pitcher being hit in the head with a batted ball during practice, and one player being struck in the head with a batted ball during warm-ups, and one player was injured during a collision between the shortstop and the second baseman. If the head first 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 1999 baseball season three high school pitchers were struck by a batted ball. There are always a number of non-school baseball injuries and the cause of injury is usually the same.

The pole vault was associated with a majority of the fatal track injuries. There have been fifteen high school fatal pole vaulting injuries from 1983 to 2001. This does not include the 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 seven permanent disability and six serious injuries. All 28 of these accidents involved the vaulter bouncing out of or landing out of the pit area. 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 fractiure. 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 to the event 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: stabilize 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. The state of Ohio has developed a program to teach proper techniques to coaches. It has been estimated that there are approximately 25,000 high school pole vaulters. If this number is correct, the catastrophic injury rate for high school pole vaulters would be higher than any of the sports included in the research. In the National Federation of State High Schools Track and Field Rules Book, Section 4, Article10, 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. At this time, there is no manufacturer that has designed a helmet for specific use in the event of pole vaulting. However, it would be permissible for an athlete to wear a helmet of his/her choosing without violating the NFHS rules.

It has been estimated that there are approximately 25,000 high school pole vaulters annually. If this number is correct, the catastrophic injury rate for high school pole vaulters would be higher than any of the sports included in the research.

There have also been 16 accidents in high school track involving participants being struck by a thrown discus, shot putt 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 but 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. There have also been spectators struck by the discus during high school meets. 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 type of accidents. Good risk management should eliminate these type of accidents. These types of injuries are not acceptable and should never happen.

The fatality in high school during lacrosse 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 2001 a high school lacrosse player was also blocking with his head and suffered permanent paralysis. Lacrosse has been a fairly safe sport when considering the fact that high school lacrosse has only been involved with five catastrophic injuries in nineteen years. A possible new area of concern are the recent lacrosse deaths being associated with players being struck in the chest with the ball and causing death (commotio cordis). There have been five cases, three high schools and two colleges, in the past four years. 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.

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 six college male lacrosse catastrophic injuries during the past nineteen years. The college death in 2001 involved a male player being struck in the chest by a ball.

For the nineteen year period from the fall of 1982 through the spring of 2001 there have been 849 direct catastrophic injuries in high school and college sports. High school sports were associated with 123 fatalities, 282 non-fatal and 284 serious injuries for a total of 689. College sports accounted for 17 fatalities, 47 non-fatal and 96 serious injuries for a total of 160. During this same nineteen year period of time there has been a total of 373 indirect injuries and all but five resulted in death. Three hundred and seven of the indirect injuries were at the high school level and 66 were at the college level. It should be noted that high school annual athletic participation for 2000-2001 includes approximately 6,657,257 athletes (3,911,076 males and 2,746,181 females). National Collegiate Athletic Association participation for 2000-2001 was 359,782 athletes. There were 208,866 males and 150,916 females.

During the nineteen year period from the fall of 1982 through the spring of 2001 there have been 106,956,521 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 0.64 per 100,000 participants. The indirect injury rate is 0.29 per 100,000 participants. If both direct and indirect injuries were combined the injury rate would be 0.93 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 0.40 per 100,000, the non-fatal rate 0.26, and the serious rate 0.27.

During this same time period there were approximately 5,723,830 college participants with a total direct catastrophic injury rate of 2.79 per 100,000 participants. The indirect injury rate is 1.15 per 100,000 participants. If both indirect and direct injuries were combined the injury rate would be 3.95. The combined fatality rate would be 1.42, the non-fatal rate 0.86, and the serious rate 1.68.

Female Catastrophic Injuries

There have been a total of 75 direct and 36 indirect catastrophic injuries to high school and college female athletes from 1982-83 - 2000-2001, which includes cheerleading. Fifty of these were direct injuries at the high school level and 25 at the college level. The 50 high school direct injuries included nine in gymnastics, 25 in cheerleading, two in swimming, two in basketball, four in track, three in softball, three in field hockey, one in ice hockey, and one in volleyball. The 31 high school indirect fatalities included nine in basketball, six in swimming, four in track, five in soccer, one in cross country, one in volleyball, one in water polo, and four in cheerleading. The 25 college direct injuries were associated with cheerleading(17), gymnastics(2), field hockey(2), skiing(1), ice hockey (1), track (pole vault)(1), and lacrosse(1). The five college indirect fatalities included one in tennis, one in basketball, one in soccer, one in gymnastics, 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 18 years there has been an average of 6.1 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 50.0% of all high school direct catastrophic injuries to female athletes and 68% at the college level. Of the 75 direct catastrophic injuries to high school and college female athletes from 1982-83 - 2000-2001, cheerleading was related to 42 or 56.0%. The cheerleading numbers have been updated from previous reports. 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.

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 team 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 catastrophic injuries.
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 and 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 football.
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.

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.

References

1. TATOR CH, EDMONDS VE: National Survey of Spinal Injuries in Hockey Players, Canada
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CASE STUDIES

FOOTBALL

HIGH SCHOOL

A high school football player was injured while being tackled in a game in September 2000. His fourth cervical vertebra was fractured and the athlete is quadriplegic.

A 17-year old high school football player was injured making a headfirst tackle during a game on September 8, 2000. He had a four-hour surgery to

fuse the fourth and fifth vertebrae. The athlete is quadriplegic.

A 16-year old high school football player was injured during a game on September 22, 2000. He was playing quarterback and was injured after an awkward fall. The athlete is quadriplegic.

A 16-year old high school football player was injured in a game on September 13, 2000. He was playing tight end and was injured while being tackled. The athlete is quadriplegic.

A 17-year old high school football player was injured in a practice on November 8, 2000. He fractured a cervical vertebra while making a tackle. The athlete is quadriplegic.

An 18-year old high school football player was injured in a game on December 9, 2000. He was a defensive back and was injured when colliding with an opposing player. The opposing player's helmet struck the athlete in the shoulder. He suffered complete avulsion of three nerve roots to his arm and has lost the use of his right arm.

A 17-year-old high school football player was injured during a game on September 15, 2000. He collapsed during the game from a head injury. The injury was a subdural hematoma and the athlete has short-term memory losses and weakness on the right side of his body.

A 17-year-old high school football player was injured during a game on October 6, 2000 while being tackled. The athlete suffered a brain injury, had surgery, was in critical condition, and recovery is incomplete.

A 15-year-old junior high school football player was injured in a game on September 28, 2000. He came to the sideline complaining of a headache, collapsed and lost consciousness. He suffered brain trauma and recovery was incomplete.

A 16-year-old high school football player suffered a subdural hematoma during a game on September 8, 2000. He was making a tackle and a second tackler hit him head to head. The athlete had a concussion one-week prior to the injury. Recovery was incomplete.

A 16-year-old high school football player was injured in a summer passing

league when he ran into another player and suffered a fractured skull. The players were not wearing helmets. He was in a coma for nine days. Recovery is incomplete.

A 16-year-old high school football player was injured during a tackling drill in practice in September 2000. He suffered an aneurysm, had surgery, and had a full recovery. He also suffered a concussion during the previous spring football practice. He will not play anymore football.

A 17-year-old running back was injured in a game while being tackled. He had surgery for a blood clot. Recovery was complete but he will not play anymore football.

A high school football player was injured after being hit by an opposing player. He complained of a headache the next day and was taken to a physician. He had surgery for a fractured cervical vertebra and had full recovery,

A 17-year-old high school football player fractured his 4th and 5th cervical vertebrae while making a tackle in a game on November 24, 2000. He had surgery and a full recovery.

A 16-year-old high school football player was injured in a game while making a tackle. He made the initial hit and other defensive players joined in the tackle. He fractured three cervical vertebrae, had surgery and recovery was complete.

A high school football player was injured in a game on August 8, 2000 after being tackled by two defenders. He fractured a cervical vertebra and recovery was complete.

A 14-year-old high school football player was hit on the helmet by a tackler after catching a pass. He had transient paralysis for several days before a full recovery.

A high school football player suffered transient paralysis and returned to play three weeks later. No other information was available.

A high school football player was injured in a game and suffered bruises to his neck and spine. He experienced initial paralysis but had a full recovery.

An 18-year-old high school running back was tackled in a game on September 8, 2000. He suffered a torn peroneal nerve and has ankle and foot paralysis.

A 16 year old high school football player died on September 15, 2000 after making a tackle in a game. The player received a blow to the chest and cause of death was listed as commotio cordis or cardiac concussion. The athlete was 6'1" tall and weighed 245 pounds. He was pronounced dead at the hospital.

A 17 year old high school football player received a brain injury on September 15, 2000 and died on September 17, 2000. The exact activity at the time of the injury was unknown. The neurosurgeon involved treating the athlete said the player died of a medium grade brain injury which he believes was complicated by abnormal structured arteries at the base of the brain that resulted in malignant brain swelling.

A 17 year old high school football player was injured in a game on September 8, 2000. The athlete was playing defense on an eight man team and was tackling the ball carrier. The helmet of the ball carrier hit the chest of the tackler. The athlete collapsed on the field and never regained consciousness. Cause of death was commotio cordis or cardiac concussion.

A 17 year old high school football player collapsed at practice on September 4, 2000 and died the following day. Cause of death was heat stroke. The athlete was 6'4" tall and weighed 305 pounds. The temperature was 77 degrees but there was high humidity.

A 15 year old high school football player collapsed after a 1 ½ mile run in hot and humid weather. The accident happened on August 9, 2000 and the athlete died on August 16, 2000. He was 6' tall and weighed 250 pounds. Cause of death was heat stroke.

A 17 year old high school football player collapsed during a preseason football practice on June 7, 2000. Coaching staff and nurses tried to resuscitate him without success. Cause of death was a congenital heart problem.

A 17 year old athlete had just finished lifting weights with the team and was running laps when he collapsed on January 18, 2000. Autopsy results

indicated a congenital problem that causes death.

A 15 year old athlete died on September 27, 2000. He collapsed on the sideline during a game. Cause of death was heart related.

A 14 year old was running a warm-up lap at practice on October 4, 2000 when he complained of chest pains. He died at the hospital with death being heart related.

A 15 year old player died on October 13, 2000 while participating in a game. Cause of death was hypertrophic cardiomyopathy

A 16 year old athlete collapsed and died at the end of practice in September 2000. The coroner stated the athlete had an enlarged heart.

A 16 year old athlete collapsed during the opening kickoff of a game on September 22, 2000. The coroner stated he died from a heart related problem.

A 15 year old athlete collapsed at a team meeting after a light workout. Cause of death was undetermined but the autopsy showed hypertrophic cardiomopathy.

COLLEGE

A 22-year-old college football player was injured in a game on October 28, 2000, while tackling in a game. He suffered damage to cervical vertebrae 1 and 2 and is quadriplegic.

A 20 year old college football player collapsed during the first spring football practice. He had emergency surgery to repair a blood clot on the brain and two collapsed lungs. Recovery was incomplete.

An 18-year-old college football player was injured while making a tackle in a game on September 23, 2000. He suffered a fractured cervical vertebra and recovery was incomplete.

A 21-year-old college defensive back was injured while making a tackle in a game on October 7, 2000. He suffered a brain hemorrhage and had surgery. Recovery was complete and he was cleared to play again, but most likely will

not play.

A college football player suffered a spinal contusion in a game on September 20, 2000. Recover was complete. No other information was available.

A 20-year-old college football player suffered an open fracture of the tibia and fibula in a game on October 14, 2000. He had a severe infection of the leg and had to have his right lower leg amputated.

A 20 year old college football player died after complaining of exhaustion following practice on August 8, 2000. Practice lasted two hours and the athlete was dressed in a helmet, t-shirt and shorts on a humid day with temperatures in the 80s. He was 6'4" tall and weighed 309 pounds. Cause of death was heat stroke.

An 18 year old player collapsed during a fitness test and died at the hospital. It happened on the first day of practice. The athlete was 5'11" tall and weighed 190 pounds. Cause of death was heat stroke.

CROSS COUNTRY

HIGH SCHOOL AND COLLEGE

NONE

SOCCER

HIGH SCHOOL

A 14 year old female high school soccer player died after colliding with another player during a game on October 4, 2000. The autopsy showed cause of death related to a berry aneurysm.

A 13 year old female soccer player collapsed at practice on September 22, 2000. She died at the hospital. The autopsy failed to determine the cause of death.

A 15 year old athlete died suddenly while playing soccer on October 12, 2000. Cause of death was heart related.

COLLEGE

A male soccer player suffered a fractured cervical vertebra during a game. While playing goalie he was hit in the head with the opponents knee. He had surgery but there was no permanent damage.

ICE HOCKEY

HIGH SCHOOL AND COLLEGE

NONE

SWIMMING

HIGH SCHOOL

A 16 year old female swimmer collapsed after swimmimg the first leg of a relay race in a meet 0n September 8, 2000. She died at the hospital. Cause of death was unknown.

COLLEGE

A 22 year old college swimmer died while jogging by himself. Cause of death was an enlarged heart.

BASKETBALL

HIGH SCHOOL

A 15 year old male athlete collapsed the first minute of a game on February 6, 2001 and died later at the hospital. Cause of death was heart related.

A 15 year old male athlete collapsed in the locker room during half time of a game on December 2, 2000. Cause of death was hear related.

COLLEGE

A male athlete collided with another player during practice on October 16, 2000 and was paralyzed for more than two hours. He had a full recovery.

A 20 year old male athlete collapsed while running in practice and died at the hospital. Cause of death was a congenital heart artery problem and cardiomyopathy.

WRESTLING

HIGH SCHOOL

A 15 year old athlete suffered a fractured neck during a routine practice session on December 27, 2000. The fourth and fifth cervical vertebrae were fractured. The athlete has permanent paralysis.

LACROSSE

HIGH SCHOOL

An 18 year old male athlete was injured while blocking an opponent with his head during a game on April 2, 2001. He is paralyzed from the chest down.

COLLEGE

A 19 year old male athlete was hit in the chest with a ball during a drill prior to a game on March 10, 2001. He was hit by a shot from a teammmate while he was standing behing the goal. He was wearing rib and shoulder pads. He died on March 17, 2001. Cause of death was commotio cordis.

BASEBALL

HIGH SCHOOL

NONE

COLLEGE

A 20 year old athlete was hit in the head by a line drive during pre-game warm-up. He was standing on the third base line when struck by a teammate's batted ball. He was not wearing a helmet. He died five days later.

A pitcher was struck in the head by a line drive off the bat of a teammate at the end of practice. He had no time to react and the ball struck him above the right eye. He suffered a severe concussion and a brain bruise. Full recovery is expected.

An athlete playing second base dove for a ground ball and collided with the shortstop. The knee of the shortstop hit the left side of the athlete's face. He had surgery to repair the damage to his face and a full recovery is expected.

TRACK

HIGH SCHOOL

A high school athlete was struck in the cheek by a javelin during a practice on April 8, 2001. The javelin pierced his cheek and neck. Recovery was complete.

A 16 year old athlete collapsed during the first outdoor track practice and died. Death was heart related.

A 14 year pold athlete died two hours after collapsing at track practice. He had a congenital heart defect.

An athlete collapsed and died during a morning track workout. No other information was available.

COLLEGE

An 18 year old female track athlete was seriously injured while pole

vaulting during an indoor meet. She bounced out of the pit and landed on the hard floor head first. She had an epidural hematoma and a skull fracture. Extent of disability not known at this time.

FIELD HOCKEY

HIGH SCHOOL AND COLLEGE

NONE

SOFTBALL

HIGH SCHOOL AND COLLEGE

NONE

TENNIS

HIGH SCHOOL

A 17 year old high school tennis player died of cardiac arrest after a tennis match. No other information was available.

WATER POLO

HIGH SCHOOL

A 15 year old female water polo player suffered cardiac arrest after playing in a varsity match. No other information was available.

GYMNASTICS

HIGH SCHOOL

A male gymnast was attempting a vault during practice, missed his landing, and fell to the mat between his shoulders and neck. He fractured a cervical vertebra and is paralyzed.

COLLEGE

A 20 year old female gymnast had been training in the weight room when she collapsed. She died five days later from a pulmonary embolism. Accident happened on November 4, 2000.

Special Section on Cheerleading

The Consumer Product Safety Commission reported an estimated 4,954 hospital emergency room visits in 1980 caused by cheerleading injuries. By 1986 the number had increased to 6,911 and in 1994 the number increased to approximately 16,000. Granted, the number of cheerleaders has also increased dramatically during this time frame. It is important to stress that catastrophic injuries have been a part of cheerleading during the last 18 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 nineteenn years, 1982-83 -– 2000-2001. There was one high school cheerleading death during the 2000-2001 school year, but it was not directly related to cheerleading. The athlete had a severe asthma attack after jogging two laps before a football game. She died at the hospital. 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 ear drum 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.
32. A college cheerleader was injured in 1997 during a tumbling routine and is now quadriplegic. She was attempting a back hand spring 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 student 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. Recover 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.

Cheerleading has changed dramatically in the past eighteen years and now has two distinctive purposes; 1) of a service-oriented leader of Cheer on the sideline; and 2) as a high 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. The Illinois State High School Association has banned the basket toss. The rule states, "cheerleaders cannot toss another squad member into the air during any part of a cheer, performance, routine or other activity. Illinois has already banned pyramid formations higher than two levels. As already stated in this report, high school and college cheerleaders account for almost one-half of the catastrophic injuries to female athletes.

The basic question that has to be asked is what is the role of the cheerleader? Fourteen states consider Cheer a sport, and organize state championship competition. Nine more organize Cheer championships as a school activity. Over 74,000 girls are participating in competitive Spirit competitions. Is cheering 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. 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 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 athletic trainer at games and practice sessions, emergency procedures must be provided. The emergency procedure should be in writing and available to 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 the proper medical authorities.
11. Cheerleading coaches should have some type of safety certification. The American Association of Cheerleading Coaches and Advisors offers this

certification.

The Michigan High School Athletic Association is the second state to recognize cheerleading as a sport. West Virginia incorporated cheerleading into athletics seven years ago. Michigan will have a committee define the sport and will have a state Cheerleading Tournament. Rules and regulations will now govern cheerleading and this is an important move toward a safer activity. Also, the American Association of Cheerleading Coaches and Advisors Safety Certification Program has been implemented and over 500 coaches have participated in safety certification programs. The state of Vermont has adopted the safety certification program as their standard of care and the following NCAA Athletic Conferences have also adopted the program: the Big Ten, Southwest, Southeast and the Western Athletic Conferences.

According to the National Federation of State High School Associations, the primary purpose of spirit groups (cheerleaders) is to serve as support groups for the interscholastic athletic programs within the school. 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. 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 Ms. Cynthia Doyle.

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