CATASTROPHIC

SPORTS INJURY RESEARCH

THIRTY-FIRST ANNUAL REPORT

FALL 1982 - SPRING 2013

From the
National Center for Catastrophic Sport Injury Research
At The University of North Carolina at Chapel Hill

Website: nccsir.unc.edu

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SUMMARY

From July 1, 2012 to June 30, 2013 there were 41 catastrophic injuries at the high school (n=29) and college (n=12) level reported to the National Center for Catastrophic Sport Injury Research (NCCSIR). This translates to a rate of 0.53 injuries per 100,000 participants.

For the 31 year period from Fall 1982 through the Spring of 2013 there were 2,101 catastrophic sports-related injuries and illnesses. The majority of catastrophic events were at the high school level (80.8%) and directly attributed to the activities of the sport (66.3% acute traumatic). Of all 2,101catastrophic events, 41.9% were fatal; of the remaining 1,221 non-fatal events, 47.0% where characterized by permanent severe dysfunctional disability and 53.0% by full recovery. Fall sports comprised the majority of catastrophic events (65.9%) followed by Winter (20.5%) and Spring (13.7%) sports.

For the 31-year period, fall sports had 839 high school and 181 college *direct* catastrophic injuries (137 fatalities) and the overwhelming majority (96.6%, 985/1020) were related to football participants. Among winter sports, there were 141 high school and 35 college *direct* catastrophic injuries (11 total fatalities) and 189 high school and 65 college *indirect* (236 total fatalities) catastrophic injuries. Wrestling accounted for the highest proportion of *direct* injuries at the high school level (63/141, 44.7%), while ice hockey (13/35, 37.1%) and basketball (10/35, 28.6%) accounted for the greatest proportion of *direct* injuries at the college level. Basketball accounted for the greatest proportion of *indirect* catastrophic injuries at both the high school (143/189, 75.7%) and college levels (44/65, 67.7%). Spring sports were associated with 153 high school and 44 college *direct* catastrophic injuries (53 total fatalities) and 75 high school and 15 *indirect* (87 total fatalities). Baseball, track and field, and lacrosse accounted for the greatest proportion of *direct* injuries at both the college and high school levels. Track and field

accounted for the greatest proportion of *indirect* injuries at the high school level. Individually, ice hockey, football, and gymnastics had the highest rates of *direct* catastrophic injury in both high school and college level. Water polo, football, and basketball had the highest *indirect* catastrophic injury rate at the high school level. At the college level, basketball, skiing, football, water polo, and ice hockey had the highest rate of *indirect* catastrophic injury.

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INTRODUCTION

In 1931, the American Football Coaches Association (AFCA) 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 (NCAA) 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 making it illegal to make initial contact with the head and face while blocking and tackling, the National Operating Committee on Standards for Athletic Equipment (NOCSAE) 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 (NCCSIR) was established in 1982. The decision to expand this 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.

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, is the Medical Director of the NCCSIR and has been responsible for evaluating the medical data. Dr. Cantu is also a Past-President of the American College of Sports Medicine. The NCCSIR has been directed for the

past 30 years by Dr. Frederick Mueller. Dr. Mueller retired in the Spring of 2013 and the NCCSIR continues under new direction (Dr. Kucera). The NCCSIR has expanded to become a consortium of universities (University of North Carolina, Boston University, University of Washington, University of Connecticut, University of Colorado) with expertise in head/neck, cardiac, and heat-related sports medicine (these three areas account for the overwhelming majority of catastrophic events).

METHODS

Outcome Definition

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 NCAA, the National Federation of State High School Associations (NFHS), and the 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.

Participation in High School and College Sports

High school annual athletic participation for 2012/13 included approximately 7,364,793 athletes (4,386,097 males and 2,978,696 females). National Collegiate Athletic Association participation for 2012/13 in championship sports was 463,202 athletes. There were 262,249 males and 200,953 females. There were also 3,396 males in non-championship sports (archery, badminton, bowling, equestrian, rowing, rugby, sailing, and squash) and 2,612 females participating in emerging sports (archery, badminton, equestrian, rugby, sand volleyball, squash, synchronized swimming, and team handball).

During the entire 31 year period from the fall of 1982 through the spring of 2013, there were 192,274,393 high school athletes participating in the sports covered by this report and approximately 10,647,735 college participants (Figure I in Appendix Tables).

Analysis

Incidence rates of catastrophic injury were calculated based on 31-year participation estimates received from the National Federation of State High School Associations and the National Collegiate Athletic Association (see Tables for each sport in Appendix Tables).

It is important to note that information is continually being updated due to the fact that catastrophic injury information may not always reach the NCCSIR 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 NCCSIR. The authors acknowledge that not every catastrophic injury is included in this report.

RESULTS

Overall Summary

For the 31 year period from Fall 1982 through the Spring of 2013 there were 2,101 catastrophic sports-related injuries and illnesses at the high school and college level reported to the National Center for Catastrophic Sport Injury Research (NCCSIR). The majority of catastrophic events were at the high school level (80.8%) and directly attributed to the activities of the sport (66.3% acute traumatic). Of all 2,101 catastrophic events, 41.9% were fatal; of the remaining 1,221 non-fatal events, 47.0% where characterized by permanent severe dysfunctional disability and 53.0% by full recovery. Fall sports comprised the majority of catastrophic events (65.9%) followed by Winter (20.5%) and Spring (13.7%) sports.

During this 31 year period, there were 1,393 direct catastrophic injuries in high school and college sports. High school sports were associated with 176 fatalities, 492 non-fatal and 465

serious injuries for a total of 1,133. High school females accounted for two deaths, 23 disability, and 23 serious direct injuries. College sports accounted for 26 fatalities, 78 non-fatal and 156 serious injuries for a total of 260 direct catastrophic injuries. College females accounted for two deaths, nine disabilities, and four serious injuries. During this same 31 year period of time, there have been a total of 684 indirect injuries and all but 26 resulted in death. Five hundred and sixty-three of the indirect injuries were at the high school level (9.6% female) and 144 were at the college level (11.1% female).

Based on participation numbers in Figure I, the high school *direct* catastrophic injury rate for 2012/13 was 0.18 per 100,000 participants. The *indirect* injury rate was 0.20 per 100,000 participants. If both direct and indirect injuries were combined, the injury rate was 0.39 per 100,000 participants. This means that approximately one high school athlete out of every 250,000 participating would receive some type of catastrophic injury. The combined direct and indirect injury rates stratified by severity were: 0.23 fatal, 0.04 non-fatal, and 0.12 serious injuries per 100,000 high school participants.

The college *direct* catastrophic injury rate during 2012/13 was 1.26 per 100,000 participants. The *indirect* injury rate was 1.76 per 100,000 participants. If both indirect and direct injuries were combined the injury rate would be 3.02 per 100,000 participants or three college athletes out of every 100,000 participating would receive some type of catastrophic injury. The direct and indirect injury rates stratified by severity were: 1.50 fatal, 0.76 non-fatal, and 0.76 serious injuries per 100,000 collegiate participants.

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 2012 football season there were a total of 11 high school direct catastrophic injuries, which is a 66% decrease from 2011. College football was associated with 5 direct catastrophic injuries in 2012 – about half as many catastrophic injuries as 2011.

There were two direct fatalities in 2012, both high school. The number of direct fatal injuries has decreased substantially over the years: since 1990 the annual number of direct fatalities has remained less than 10 (Mueller & Colgate 2012). The 1990 football report was historic in that it was 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. Furthermore, the 1994 data shows zero fatalities at the high school level and one at the college level, and in 2006 there was one high school direct fatality and none at the college level. These numbers are very low when compared to the 36 direct football fatalities in 1968, which was the highest number on record.

There were 9 indirect fatalities in the 2012 football season (7 high school level and 2 college level). Heart and heat related deaths continue to be the major cause of indirect deaths.

In addition to the above mentioned fatalities, there were six *permanent disability injuries* in 2012/13. Half were at the high school level. Fourteen were brain injuries and four were cervical spine injuries. This number is a 67% decrease when compared to 2011/12. *Serious* football injuries with no permanent disability accounted for eight injuries at the high school and

two at the college level for a total of 10 injuries (eight head/brain and two cervical spine) in 2012/13.

In 2012/13, high school football accounted for a total of 20 catastrophic injuries: nine deaths, three disability injuries, and eight catastrophic injuries with recovery. College football accounted for a total of seven catastrophic injuries which included two deaths, three disability, and two with recovery. When comparing these overall numbers to past years (1990's), there has been a significant decrease in the number of catastrophic football injuries. This 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 both the game and those participating in it. Despite this decline, the number of catastrophic injuries reported per year continues to be a major concern and must be monitored carefully.

Cross Country

In 2012/13 there were three catastrophic injuries or conditions, one direct fatality (commotio cordis) and one indirect serious injury and one indirect fatality at the college level. For the 31 years indicated in Tables I through VIII, cross-country was associated with one direct fatality, 29 indirect fatalities, one direct non-fatal injury, and three indirect serious injuries at the high school level, and two indirect fatalities at the college level. Twenty-six of the indirect fatalities were heart related, one was caused by a seizure, one by heat stroke, and the cause of three were unknown. Autopsy reports revealed congenital heart disease in four of these cases. Two indirect serious injuries at the high school level were heat stroke with recovery and one was cardiac arrest with recovery.

Soccer

Table I shows that high school soccer had no direct or indirect catastrophic injuries in 2012, for a total of 18 male and five female direct catastrophic injuries for the past 31 seasons. During 1992, there were three direct catastrophic injures, which is the highest reported. College soccer was associated with one indirect fatality in 2012, for a total of 4 direct catastrophic injuries (three male and one female) and 10 indirect catastrophic injuries (seven males and three females) for 31 year period.

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. Since then, there have been two more college direct catastrophic injuries (1999 and 2005). There have been a total of three direct catastrophic injuries (non-fatal) at the high school level, two in 1996 and one in 1999. In 2007, field hockey experienced its first indirect fatality on the high school level. There have been no direct or indirect catastrophic injuries in high school or college field hockey since 2008, including the 2012/13 year.

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. Since 1999-2000 season, there have been no reported catastrophic injuries/illnesses in water polo.

Fall Summary

In summary, high school fall sports in 2012 were associated with 11 direct catastrophic injuries, 10 of which were associated with football. Football had one fatality, with three involving permanent disability and six were considered serious. For the 31-year period 1982/83 – 2012/13, high school fall sports had 839 direct catastrophic injuries and 811, or 96.7%, were related to football participants. There were eight direct catastrophic injuries among female participants – three in field hockey and five in soccer.

In 2012, high school fall sports were also associated with 10 indirect catastrophic injuries. Nine were in football and one in cross country. For the period from 1982/83 – 2012/13 there was a total of 299 indirect fall high school catastrophic injuries. Of these indirect injuries, 292 were fatalities and 225 (77.1%) were related to football. Seventeen of the indirect fatalities involved females – nine cross-country, six soccer players, one water polo player, and one field hockey player.

During the 2012 college fall sports season, there were five direct catastrophic injuries. All of these were due to football (three non-fatal and two serious injuries). For the 31 years, 1982-2013 there were a total of 181 college direct fall sport catastrophic injuries, and 174 were associated with football. Four were associated with soccer and three with field hockey. There were four indirect college fatalities during the fall of 2012, two in football, one in soccer, and one cross country. From 1982 through the 2012 fall season, there were a total of 64 college fall sport indirect catastrophic injuries, and 62 of them were fatalities. Fifty-one of the indirect fatalities were associated with football, ten in soccer, two 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 31-year rate of direct injuries per 100,000 high school football participants was 0.28 fatalities, 0.87 non-fatal injuries and 0.80 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 (fatal, non-fatal and severe) have injury rates of less than one per 100,000 participants. Table IV shows that the indirect fatality rates for high school football, soccer, cross country, and water polo are similar and are also less than one per 100,000 participants.

College football has approximately 72,000 participants each year and the direct injury rate per 100,000 participants is higher than the other fall sports. The rate for the 31-year period indicated in Table VI, for college football fatalities is less than one per 100,000 participants with higher rates for non-fatal (1.84 per 100,000) and serious injuries (5.48 per 100,000) participants. Indirect fatality rates per 100,000 college participants vary by sport with football and water polo the highest (2.29 and 3.29 respectively) followed by soccer (0.92) and cross-country (0.58).

There were four college female athletes receiving a direct catastrophic injury in a fall sport for this 31-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 college female indirect deaths in soccer.

Winter Sports (Appendix Tables IX - XVI)

As shown in Table IX, high school winter sports were associated with no direct catastrophic injuries in 2012/13. There were four indirect fatalities at the high school level in 2012/13; two in basketball, one in swimming, and one in wrestling. College winter sports were also associated with no direct catastrophic injuries in 2012/13. There was one indirect serious basketball injury in which the athlete experienced cardiac arrest but survived. There was also one indirect fatality in swimming in 2012/13 (Tables XIII – XVI).

A summary of high school winter sports, 1982/83 – 2012/13, shows a total of 141 direct catastrophic injuries (nine fatalities, 76 non-fatal, and 56 serious) and 189 indirect (179 fatalities, one disability, and nine serious). Wrestling was associated with 63 or 44.7% of the direct injuries. Gymnastics and swimming were associated with 13 (9.2%) of the direct injuries. Basketball was associated with 22 (15.6%), ice hockey was associated with 29 (20.6%), and volleyball one (0.70%). Basketball accounted for the greatest number of indirect catastrophic injuries with 143 (75.7%) of the winter total.

College winter sports from 1982/83 – 2012/13 were associated with a total of 35 direct catastrophic injuries. The majority of these events were in ice hockey with 13 (37.1%), basketball with ten (28.6%) followed by gymnastics with seven (20.0%), skiing and wrestling each with two (5.7%), and swimming with one (2.9%). There were also 65 indirect injuries (57 fatalities) during this time period. The majority were associated with basketball (n=44, 67.7%), followed by ten in swimming (15.4%), four in wrestling (6.2%), three in ice hockey (4.6%), and two in volleyball (3.0%), and one each for skiing and gymnastics (1.5%).

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 244,000 male and 2,470 female participants each year. High school basketball and swimming were also associated with low direct injury rates. As shown in Table X, high school ice hockey and gymnastics, for both males and females, were associated with the highest direct injury rates for the winter sports. Gymnastics has averaged approximately 3,550 males and 23,660 female participants during the past 31 years. Ice hockey averaged 29,176 male and 3,753 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, with men's basketball having the highest fatality rate (0.74).

Catastrophic direct injury rates for college winter sports are higher when compared to high school figures. Gymnastics had six non-fatal (three female), and one serious injury for the past 31 years, but the non-fatal injury rate is 17.68 per 100,000 male participants and 6.52 per 100,000 female participants. Participation figures show approximately 548 male and 1,485 female gymnastic participants each year.

College ice hockey was associated with eight serious (one female) and five non-fatal direct injuries in 31 years. There are approximately 3,854 male ice hockey participants each year. Among males, the direct non-fatal injury rate was 4.20 per 100,000 participants and the serious injury rate was 5.86 per 100,000 participants. The first female college ice hockey player received a direct serious injury during the 1999-2000 season. The serious injury rate for females was 3.65 injuries per 100,000 participants and females averaged approximately 885 participants per year for the past 31 years. Swimming non-fatal incidence rates were not as high as

gymnastics or ice hockey. There has not been a direct injury in college swimming since the one non-fatal injury in 1982/83.

College wrestling had only two direct catastrophic injuries from the fall of 1982 to the spring of 2013. For this period of time there were 208,461 participants in college wrestling for an average of approximately 6,727 per year. The injury rate for this 31 year period of time was 0.96 per 100,000 participants. College skiing has approximately 659 female participants each year, and the one fatality and one non-fatal injury produced a twenty-four year injury rate of 5.74 per 100,000 participants for each injury. These were the only skiing direct catastrophic injuries since the study was initiated for skiing in 1990.

Injury rates for male college indirect fatalities were also high when compared to the high school rates. Basketball had an injury rate of 7.36 fatalities per 100,000 male participants, skiing 5.18, ice hockey 0.84, and swimming 3.15. The year 1997-98 was the first year there were any indirect fatalities in wrestling. These three deaths were due to heat stroke associated with wrestlers trying to make weight for a match. There was also an indirect fatality in 2010-2011. The indirect injury rate for wrestling was 1.92 per 100,000 participants.

The female indirect injury rate for basketball was 1.23 per 100,000 participants, 0.73 for volleyball, 0.69 for swimming and 2.17 for gymnastics.

Spring Sports (Appendix Tables XVII - XXIV)

High school spring sports were associated with one direct catastrophic injury in 2013. It occurred in track and was a fatality. High school spring sports were also associated with one indirect catastrophic fatality in 2013 – in baseball. College spring sports were associated with one indirect fatality in baseball.

From 1983 through 2013, high school spring sports were associated with 153 direct catastrophic injuries (Table XVII). Forty were listed as fatalities, 46 as catastrophic non-fatal and 67 as serious. Track and field accounted for 66 cases, baseball accounted for 65, lacrosse had 15, and softball had 7. Injury rates were less than one per 100,000 participants for each sport in all categories, with the exception of male softball that had a fatality rate of 2.66 per 100,000. There were nine direct injuries to females in track and field, six in softball, and two in lacrosse. There were also 75 indirect catastrophic injuries (73 fatal) in high school spring sports during this time span (Table XIX). Forty-two were related to track and field, 20 in baseball, eight in lacrosse, four in tennis, and one in golf. Seven of the indirect fatalities involved female track and field athletes.

As illustrated in Table XXI, college spring sports were associated with 44 direct catastrophic injuries from 1983 to 2013. Thirteen of these injuries resulted in fatalities, 17 were listed as non-fatal and 14 were listed as serious. Baseball accounted for 18 injuries, track and field for 13, lacrosse for 11, and softball and equestrian for one each. College females were associated with two non-fatal injuries in lacrosse, one in track and field, a serious injury in softball, and one fatality in equestrian. Table XXIII shows there were also 15 indirect catastrophic injuries (14 fatal) in college spring sports during this time. Two indirect fatalities

were associated with tennis, two were associated with track and field, five 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 428,472 male players and 917 female players each year, track and field 531,598 males and 432,108 females, and tennis 144,370 males and 152,795 females. The baseball figures do not include the 324,448 female softball participants each year (plus 1,211 males). Lacrosse has approximately 43,096 male and 30,576 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, softball one serious injury and female track and field (pole vault) was associated with one non-fatal injury. Equestrian was associated with a female fatality. Participation figures reveal approximately 6,563 men and 4,746 women lacrosse players each year.

Rates for indirect college fatalities in baseball, tennis, track and field, and lacrosse are low with rowing being slightly higher. There were two indirect tennis fatalities, one male and one female, but participation figures are low. Men average approximately 7,726 and women 8,005 participants each year. Men's rowing had the highest indirect injury rate at 10.72 injuries per 100,000 male participants and 0.00 for female participants. There are approximately 2,153 male rowers and 6,950 female rowers each year (Figure I in Appendix Tables).

DISCUSSION

Football

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 direct 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 (1931-2013) and the recommendations that were based on that data. Non-fatal football injuries or permanent disability decreased to one for college football in 1983, 1988, 1991, 1995, 1999, 2004, 2005, and 2009, and zero in 1986, 1987, 1992, 1993, 1998, 2001, 2007, 2008, and 2011.

There was a dramatic reduction in high school disability injuries in football from 13 in 1990 and 1993 to five in 1994. The 2006 data show 17 non-fatal injuries (head and neck combined) and one fatality in high school football. The 2008 data show 21 head and neck disability injuries and seven fatalities in high school football. In 2009 there were 16 head and neck injuries in high school football with disability and two deaths. In 2010 there were 10 disability injuries and two fatalities. But in 2011, numbers increased to 18 disability injuries with two fatalities. Permanent disability injuries in football have seen dramatic reductions when compared to the data from the late 1960's and early 1970's, but the 2008 and 2009 data are a dramatic increase and a major concern. In addition, there were four serious injuries in high school football in 2006, but a dramatic rise to 19 in 2007 and 23 in 2008, 16 in 2009, and ten in 2010. A total of 51 catastrophic injuries in high school football during the 2008 season (seven deaths, 21 disability, and 23 serious) was an all-time high and a substantial increase from previous years. 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. The number dropped to 34 in 2009 (two deaths, 16 disability, and 16 serious) and 22 in 2010 (two deaths, 10 disability, and 10 serious). But in 2011, the numbers increased to 33 with two deaths, 18 disability, and 13 serious injuries.

College football in 2009 was associated with a total of eight catastrophic injuries – seven were serious head or neck injuries with full recovery and one involved permanent disability. In 2010 there were five catastrophic injuries (one fatality, two disability, and two serious) and in 2011 there were 8 catastrophic injuries (one fatality, zero disability, and seven serious).

The NCAA Committee on Competitive Safeguards and Medical Aspects of Sports in a December 2009 meeting recommended that an athlete would be sidelined for at least the rest of the day if he/she loses consciousness or shows other worrisome symptoms during competition. The panel also recommended sidelining an athlete with less severe concussion-related symptoms until cleared by a physician. A new NFHS concussion rule for the 2010-2011 sport seasons will apply to all sports and states the following: "Any player who exhibits signs, symptoms or behaviors consistent with a concussion (such as loss of consciousness, headache, dizziness, confusion or balance problems) shall be immediately removed from the contest or practice and shall not return to play until cleared by an appropriate health-care professional. An athlete with a concussion shall not be allowed to continue playing in a game or practice the same day and may not return to play in subsequent days without being cleared by a medical professional."

As of 2013, new rules regarding the loss of a helmet during play have been implemented by the NFHS. The first rule (rule 9-4-3l) states that, "Initiating contact with a helmet-less opponent is now an illegal personal contact foul," and the second (rule 9-6-4g) states, "Players continuing to play without a helmet is now illegal participation." Although football catastrophic

injuries may never be totally eliminated, but substantial 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 prohibited initial contact with the head in blocking and tackling. Continued emphasis in this area by coaches and officials is recommended.
2. The NOCSAE football helmet standard went into effect at the college level in 1978 and at the high school level in 1980. Continued research in helmet safety is recommended.
3. Medical care of injured athletes has improved due to recent concussion prevention and management legislation passed in 49 U.S. states and continued emphasis on placing certified athletic trainers in all high schools and colleges. A written emergency plan for catastrophic injuries both at the high school and college levels is strongly recommended.
4. Improved coaching technique when teaching the fundamental skills of blocking and tackling.
5. 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 32 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 – 1931-2012 (Mueller & Colgate 2012), there were recommendations for safety during football activity in hot weather. New regulations by the National Collegiate Athletic Association (NCAA) for volunteer summer conditioning programs and pre-season football practice went into effect during the 2003 season. Thirteen

state high school associations have adopted similar guidelines between 2011 and 2013. See the following The Korey Stringer Institute webpage for detailed information on these policies: http://ksi.uconn.edu/prevention-strategies/high-school-state-policies/heat-acclimatization-state-policies/.

Soccer

Concussion injuries related to heading the ball 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 or head-to-ground 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 (Kirkendall & Garrett 2001). The authors report 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. 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 (American Academy of Pediatrics, 2000, page 660." 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 2010-2011 rules have a new rule related to concussions and a point of emphasis related to concussion management. This emphasis has also been extended to the 2012/13 season as well.

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 children 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. 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. 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.

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 should be 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 children cannot move or play on them without supervision.
5. Take soccer goals apart and store at the end of a season so children cannot play on them.

On May 4, 1999, the CPSC 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."

Safety Resources:

- For a free copy of "Guidelines for Movable Soccer Goal Safety," visit www.cpsc.gov and click on the Safety Education tab. In 2012, there will be a ban on the manufacturing or sale of movable soccer goals that are not tip-resistant.
- A list of guidelines is available for movable soccer goal safety and warning labels. To obtain a copy of guidelines and warning labels, please visit: http://anchoredforsafety.org/coaches_clubs_warning_labels.html.

Wrestling

High school wrestling has been associated with 63 direct catastrophic injuries during the past 31 years (two per year). Due to the fact that college wrestling was only associated with two catastrophic injuries 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 1998-1999 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 2006-2007 stronger guidelines discouraging rapid weight loss will take effect. New wrestling rule books also have rules related to concussion injuries and a section on concussion management.

There is also a national trend for an increased number of females participating in wrestling. In 2012/13, there were 8,727 females in high school wrestling. As stated earlier, the concussion rule for all high school sports has been changed.

Ice Hockey

The number of ice hockey injuries is low, but the injury rate per 100,000 participants is high when compared to other sports: direct rate of injury per 100,000 male participants is 2.87 high school and 10.04 college. 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. After an in-depth study of ice hockey catastrophic injuries in Canada, Dr. Tator found that 20% of children on ice hockey teams suffer concussions. Dr. Tator has made the following recommendations concerning prevention (Tator & Edmonds 1984):

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.

NFHS has added a new rule (rule 6-41-3) for the 2013-14 season that states, "No player shall deliver a check to an unsuspecting and vulnerable player." (NFHS 2013-14 Rule Book)

Swimming and Diving

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 supports that effort. There has not been a direct college injury for the past 31 years. High school swimming, however, has been associated with 13 direct catastrophic injuries and the racing dive in the shallow end of the pool has been involved in all cases. 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 ten years. The competitive racing start has changed and now involves the swimmer getting more depth when entering the water. Practicing or starting races in the deep end of the pool or being extremely cautious could also 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 2011-2012 (Rule 2-7-2) has new water depth rules for the 2011-2012 season: in water starts must be used when water depth is less than 4 feet. It has also been adopted by the NCAA and USA Swimming to minimize the risk of participants strike the bottom of the pool on the racing start. The adoption of these new rules supports the importance of constant data collection and analysis. Rules and equipment changes for safety reasons must be based on reliable injury data. The NCCSIR has not received any information concerning high school or college direct catastrophic swimming injuries since the 2001-2002 season.

Gymnastics

Men's and women's gymnastics were also associated with higher direct injury rates at both the high school (1.23 and 3.64 per 100,000 female and male participants) and college levels (6.52 and 23.56 per 100,000 female and male participants). Gymnastics needs additional study at both levels of competition due to a dramatic participation reduction with the major emphasis being in private clubs.

Baseball

High school spring sports have been associated with low incidence rates during the past 31 years, but baseball was associated with 65 direct catastrophic injuries. In 2013, there were no direct high school baseball catastrophic injuries, despite there being one direct fatality and four direct serious injuries in 2012. 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.

Softball

There have been no catastrophic injury events in softball for 2012/13. The 2006 rule change in fast pitch soft ball required players to wear batting helmets equipped with NOCSAE approved facemasks/guards. Effective in the 2010-2011season for fast pitch softball, the pitching distance will be moved back to 43 feet. State associations were permitted to adopt the

43 feet distance in 2009-2010. This safety rule should result in fewer strikeouts and more action with more balls being hit into play.

Track and Field

In 2013, there was one fatality in high school Track and Field. The pole vault has been associated with a majority of the fatal track and field injuries in the past. There were 43 high school catastrophic injuries in pole vaulting during the past 31 years out of a total of 66 track and field catastrophic injuries. It has been estimated that there are 80,000-90,000 high school pole vaulters annually (Boden et al. 2012). Based on these estimates, the catastrophic injury rate for high school pole vaulters would be approximately 1.59 to 1.79 catastrophic injuries per 100,000 participants. These estimated rates are similar to the high school direct catastrophic injury rates for gymnastics (1.54) and football (1.95) during the same 31-year period. 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. Most pole vaulting accidents involve 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.

Whenever there is a pole vaulting death, there are more people supporting the elimination of this 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, padding the pole-

vault standards, removing all hazards from around the pit area, and controlling 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 5, Article 9, 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 NFHS permits a high school athlete to wear a helmet of his/her choosing without violating the NFHS rules. A helmet designed exclusively for pole vault 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 however, helmets will continue to be an option for pole vaulters.

There have also been 22 accidents in high school track and field involving participants being struck by a thrown discus, shot put or javelin (Table 1). There have also been spectators struck by the discus during high school meets. There were no such accidents in 2011, 2012, and 2013. The National Federation of State High School Associations put a new rule in for the 1993 track and field season that fenced off the back and sides of the discus circle to help eliminate this type of accident. However, despite such rules, these events still occur as evidenced in Table 1.

Good risk management should eliminate these types of accidents and safety precautions must be continued to be stressed for these events in both practice and competitive meets.

TABLE 1

TRACK PARTICIPANTS AND SPECTATORS STRUCK BY THROWN OBJECTS

1992-2013

Year	Number	Case details
1992	1 (fatal)	Female athlete was struck by a thrown discus in practice and died.
1993	1	Track manager was struck in the neck by a javelin and recovered.
1994	1	Female track athlete was struck in the face by a javelin and recovered.
1995	1	Male athlete was struck in the head by a shot put during warm-ups and had a fractured skull.
1997	1 (fatal)	Male athlete was struck by a discus and died.
1998	1 (fatal)	Female athlete was struck by a discus and died.
1998	1	Male athlete was struck in the head by a shot put and recovered.
1999	2	Male athlete was struck by a javelin; female athlete was struck by a discus.
2000	1	Junior high school athlete struck in the head by a discus and has permanent disability.
2001	1	High school athlete was struck in the cheek with a javelin during practice.
2002	5	Three athletes struck by a shot put and one by a discus; coach was struck by a shot put.

TABLE 1 CONTINUED…

2005	3 (1 fatal)	Male track athlete was hit in the head with a shot put and in

		critical condition; track athlete was impaled with a javelin in the shoulder; an official died after being struck in the head by a shot put.
2006	1	Male track athlete was hit in the head with a javelin which went four inches into his brain and recovered.
2007	2	Female track athlete was struck in the ankle by a javelin and needed a bone graft; female was struck in the head by a shot put, had surgery, and recovered.
2008	1	Female was struck in the head by a discus.
2010	1	High school female track athlete was hit in the face by a discus
2013	1 (fatal)	Male high school track athlete was hit by a metal discus in the hip. He passed away unexpectedly a week after the initial injury. Cause of death unknown.
TOTAL	25 (5 fatal) –	Note 3 incidents were to coaches and officials

Lacrosse

Lacrosse has been a fairly safe sport when considering the fact that high school lacrosse has been involved with 15 direct catastrophic injuries in 31 years (13 male and two females). 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 nine cases in the past 13 years (six deaths--three in high school [one during a high school club team] and three during college [one during summer camp]). The most recent commotio cordis accident happened in 2011 when the player was struck in the chest by a shot. He was saved by the use of CPR and an AED. Currently there is research being funded by NOCSAE that is studying chest protectors to help reduce commotio cordis fatalities. The NCCSIR and the lacrosse community will continue to monitor these types of deaths; future work should involve in-depth evaluations of these injuries to learn how they can be prevented.

Catastrophic eye injuries have been a concern in female lacrosse. 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 (Lincoln et al. 2012).

Injury rates were higher in college lacrosse compared to other college spring sports. There have been nine college male and two female lacrosse catastrophic injuries during the past 30 years. The college death in 2005 involved a male player being struck in the neck by a ball. Also in 2005 during a college club lacrosse game, 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 was one direct serious injury with recovery to a female high school lacrosse player in 2010. 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 (Covassin, et al. 2003).

FEMALE CATASTROPHIC INJURIES

There have been a total of 134 *direct* and 62 *indirect* catastrophic injuries to high school female athletes from 1982/83 – 2012/13, which includes cheerleading (86 direct and 8 indirect). College females accounted for 52 *direct* and 16 *indirect* catastrophic injuries (including cheerleading 37 direct and 0 indirect) for the same time period. The 134 high school *direct* injuries included four deaths, 57 disability, and 73 serious injuries. Stratified by sport, the greatest number of high school *direct* injuries were in cheerleading (over half at 64.2%), followed by gymnastics, track and field, softball, swimming, and basketball (Table 2). Of the 62 high school *indirect* catastrophic injuries, basketball had the highest number followed by cheerleading, swimming, cross country, track and field, soccer, and volleyball (Table 3). Over half of the 52 college *direct* injuries were associated with cheerleading (71.2%); followed by gymnastics, field hockey, skiing, and lacrosse (Table 4). Roughly one third of the 16 college *indirect* injuries were from basketball followed by soccer, swimming, and volleyball (Table 5).

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 31 years there has been an average of 8.6 per year. A major factor in this increase has been the change in cheerleading activity, which now involves gymnastic type stunts. High school cheerleading accounted for 64.2% of all high school direct catastrophic injuries to female athletes (two males not included) and 71.2% at the college level (four males not included). Of the 186 *direct* catastrophic injuries to high school and college female athletes from 1982/83 – 2012/13, cheerleading was related to 123 or 66.1%. The cheerleading numbers have been updated from previous reports and male cheerleaders were not included. Given the difficulty and complexity of these types of stunts (e.g., pyramids, basket tosses of twenty feet), experience and training of the coach as well as the

performance environment will be important areas for future research and intervention. See the special section in this report on cheerleading for more information.

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 2

HIGH SCHOOL FEMALE DIRECT CATASTROPHIC INJURIES

1982/83 – 2012/13

SPORT	FATALITY	NON-FATAL	SERIOUS	TOTAL
Cheerleading*	2	34	50	86
Gymnastics	0	6	3	9
Track and field	1	2	6	9
Swimming	0	4	1	5
Basketball	0	2	3	5
Ice Hockey	0	1	2	3
Field Hockey	0	3	0	3
Softball	1	3	2	6
Lacrosse	0	0	2	2
Soccer	0	1	4	5
Cross Country	0	0	1	1
Volleyball	0	1	0	1
TOTAL	**4**	**57**	**73**	**134**

TABLE 3

HIGH SCHOOL FEMALE INDIRECT CATASTROPHIC INJURIES

1982/83 – 2012/13

SPORT	FATALITY	NON-FATAL	SERIOUS	TOTAL
Basketball	16	0	1	17
Swimming	7	0	2	9
Cheerleading*	8	0	2	10
Cross Country	9	0	1	10
Soccer	6	0	1	7
Track and field	7	0	0	7
Volleyball	1	1	0	2
Water Polo	1	0	0	1
Field Hockey	1	0	0	1
TOTAL	**56**	**1**	**7**	**64**

TABLE 4

COLLEGE FEMALE DIRECT CATASTROPHIC INJURIES

1982/82 – 2012/13

SPORT	FATALITY	NON-FATAL	SERIOUS	TOTAL
Cheerleading*	1	12	24	37
Field Hockey	0	1	2	3
Lacrosse	02	0	2	
Gymnastics	0	3	0	3
Equestrian	1	0	0	1
Soccer	0	1	0	1
Ice Hockey	0	0	1	1
Skiing	1	1	0	2
Track & field (Pole Vault)	0	1	0	1
Softball	0	0	1	1
TOTAL	**3**	**21**	**28**	**52**

TABLE 5

COLLEGE FEMALE INDIRECT CATASTROPHIC INJURIES

1982/83 – 2012/13

SPORT	FATALITY	NON-FATAL	SERIOUS	TOTAL
Soccer	3	0	0	3
Basketball	5	0	1	6
Tennis	1	0	0	1
Volleyball	2	0	0	2
Gymnastics	1	0	0	1
Swimming	2	0	1	3
TOTAL	**14**	**0**	**2**	**16**

RECOMMENDATIONS FOR PREVENTION

1. Mandatory medical examinations and a thorough medical history should be taken before allowing an athlete to participate.
2. All personnel concerned with training athletes should emphasize proper and appropriate physical conditioning in order to prepare the athlete 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.
4. There should be a written emergency procedure plan to deal with the possibility of a catastrophic injury.
5. There should be an emphasis on employing well trained athletic personnel, providing excellent facilities and securing the safest and best equipment available.
6. There should be strict enforcement of game rules and administrative regulations to protect the health of the athlete and reduce the risk of catastrophic injury. Coaches and school officials must support the game officials in their rulings during the sporting event.
7. Coaches should be educated on and have the ability to teach the proper fundamental skills of the specific sport. Specific to football, the proper fundamentals of blocking and tackling should be emphasized to help reduce head and neck injuries, especially with keeping the head out of blocking and tackling.
8. Coaches should have the training and experience needed to teach the skills of the sport and to properly train and develop the athletes for competition.
9. 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.

10. There should be continued safety research in athletics (rules, facilities, equipment).
11. All athletes and athletic personnel should follow the state, NFHS, and NCAA policies related to concussion and return to play. See the following CDC resource for a list of states with concussion policies: http://www.cdc.gov/concussion/policies.html.
    - For the most up to date information on concussion management please see the updated Consensus Statement on Concussion in Sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012 (McCrory et al. 2013).
    - When an athlete has experienced or shown signs of head trauma (e.g., 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/game that day.
    - 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).
    - Athletes and their parents should be informed about the risks of concussion and other injuries, as well as how to manage them.

The NCAA has created several rules to help manage concussion injuries. The NCAA has created a set of best practices that are available in the Sports Medicine Handbook. A free download for 2013-2014 may be found at: http://www.ncaapublications.com/p-4328-2013-14-ncaa-sports-medicine-handbook.aspx

Every NCAA member school is required to have a concussion-management plan that:

- Requires student-athletes to receive information about the signs and symptoms of concussions. They also are required to sign a waiver that says they are responsible for reporting injuries to the medical staff.
- Mandates that institutions provide a process for removing a student-athlete from play/participation if they exhibit signs of a concussion. Student-athletes exhibiting signs of a concussions must be evaluated by a medical staff member with experience in the evaluation and management of concussions before they return to play.
- Prohibits a student-athlete with concussion symptoms from returning to play on the same day of the activity.
- Requires student-athletes diagnosed with a concussion be cleared by a physician before they are permitted to return.

CASE STUDIES 2012/13 SEASONS
*Compiled from available media reports.

FOOTBALL

Note: High school and college case studies in football are not duplicated for this report. They are included in the annual football reports available on the NCCSIR website – nccsir.unc.edu.

BASEBALL HIGH SCHOOL

A male 17 year old high school senior baseball player was attending an off-season conditioning session when he collapsed. Coaches and athletic trainers were on scene immediately. He was transported to the hospital (in stable condition) but later died. Cause of death was due to hypertrophic cardiomyopathy (HCM).

BASEBALL COLLEGE

A male 20 year old college sophomore baseball player collapsed during baseball practice. He was taken to the hospital but later died. Cause of death was due to Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy (ARVD/C).

BASKETBALL HIGH SCHOOL

A male 16 year old high school basketball player was at a preseason practice session when he told a teacher that he wasn't feeling well. He stepped to the side, got down on one knee, and collapsed. CPR and AED were used prior to him being transferred to the hospital. He died a few days later. Reports indicate that he was medically cleared to play. Cause of death was due to "natural causes" and no autopsy was performed.

A male 17 year old high school junior basketball player collapsed during a time out. CPR was administered until paramedics arrived. He was taken to the hospital but died shortly after. Cause of death is due to myocarditis, a viral infection of the heart.

BASKETBALL COLLEGE

A male 22 year old college junior basketball player was practicing before a game when he collapsed and stopped breathing. The athletic trainer administered CPR and used an AED. He spent 4 days in the hospital in which a defibrillator was implanted into his heart. He is expected to have a full recovery with no longstanding effects.

CROSS COUNTRY HIGH SCHOOL

A female 16 year old high school junior cross country runner was practicing when she collapsed. CPR and AED were administered. She was taken to the hospital where she remained in a coma. She woke up a few days later. She sat out the remainder of the cross country season but was made an assistant coach. Reports indicate that a pacemaker may have to be implanted. She is suspected to have a full recovery.

A male 14 year old high school freshman cross country runner collapsed while warming up for cross country championships. He slipped in the mud and landed on his chest, which caused cardiac arrest (commotio cordis). No ambulance or AED were available on site. He died 5 days

later as a result of his injuries. Cause of death was due to cardiac arrest. Family has filed a negligence and wrongful death lawsuit.

CROSS COUNTRY COLLEGE
A male 20 year old college junior cross country runner collapsed while at the cross country meet. Circumstances surrounding his collapse are unknown. He was immediately attended to by passing runners, one of whom administered CPR and rescue breaths, before medical personnel arrived. Another runner ran to call 911. He passed away 2 weeks later. Cause of death is unknown.

SOCCER COLLEGE
A male 19 year old college sophomore soccer player collapsed during practice. He was taken to the hospital but died shortly upon arriving. Cause of death is undisclosed but a few reports indicate that he had an undetected heart defect.

SWIMMING HIGH SCHOOL
A male 16 year old high school junior swimmer collapsed during swim practice and was pulled from the pool unconscious. Efforts from paramedics to resuscitate him were unsuccessful. He was taken to hospital and pronounced dead shortly after. Cause of death was due to cardiomyopathy.

SWIMMING COLLEGE
A male 19 year old college sophomore swimmer did not show up on second day of swim meet. He was found unconscious in his dorm room and pronounced dead shortly after at the hospital. Cause of death was due to sudden cardiac arrest. He had previously collapsed (1 year prior) and was diagnosed with Wolff-Parkinson-White Syndrome but was cleared to swim.

TRACK & FIELD HIGH SCHOOL
A male 15 year old high school freshman track and field player was stretching for an event when he was hit by a metal discus on the hip. Athletic trainers advised him to ice his hip, watch for swelling, and if pain increased, go to the hospital. He went to the hospital for follow-up exam two days later and was discharged with a diagnosis of a bruised hip. He returned to the ER after another two days when his pain increased and was admitted to the ICU. He passed away unexpectedly a week after the initial injury. Cause of death remains unknown.

WRESTLING HIGH SCHOOL
A male 16 year old high school junior wrestler was jogging at wrestling practice when he collapsed and went into cardiac arrest. He died shortly after. Cause of death is unknown but reports suspect cardiac arrest.

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. The number steadily increased over the next 31 years to 6,911 in 1986, 16,000 in 1994, 21,906 in 1999, and 28,414 in 2004, and 36,288 in 2010. Of those injuries reported in 2010, head and neck injuries accounted for 19.3% and facial injuries accounted for 6.3%. In 2010, head injuries were associated with 1,579 concussions, 361 contusions, and 2,292 internal injuries. Neck injuries accounted for 79 contusions, 60 fractures, and 1,325 sprains/strains. Neck injuries were associated with 118 contusions, 16 fractures, and 1,301 sprains/strains. Of all these cheerleading injuries, 98% of cases were treated and released. Despite this high percentage, there were still 291 athletes hospitalized, 71 treated and transferred to another hospital, and 49 held for observation. This brings attention to an important goal for cheerleading coaches and organizations to keep in mind—focus should be spent on eliminating head and neck injuries and increasing overall awareness of safety standards. One catastrophic injury is too many, especially considering the vast increase in the number of cheerleading participants over the years.

Results

The National Center for Catastrophic Sports Injury Research (NCCSIR) has been collecting cheerleading catastrophic injury data for the past 31 years (1982/83-2012/13, see Tables 6 and 7). During the 2012/13 school year, there were no new catastrophic injuries reported in either high school or college level. However, NCCSIR captured three new catastrophic injuries in high school cheerleading from previous years (2011, 2004, and 2003).

TABLE 6

HIGH SCHOOL CHERLEADING DIRECT CATASTROPHIC INJURIES

1982/83 – 2012/13

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	4	3	7
2004-2005	0	1	5	6
2005-2006	1	0	10	11
2006-2007	0	1	3	4
2007-2008	0	3	0	3
2008-2009	0	2	1	3
2009-2010	0	3	0	3
2010-2011	0	1	0	1
2011-2012	0	0	1	1
2012-2103	0	0	0	0
TOTAL:	**2**	**34**	**50**	**86**

TABLE 7

COLLEGE CHEERLEADING

DIRECT CATASTROPHIC INJURIES

1982/83 – 2012/13

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	1	2	3
2007-2008	0	1	2	3
2008-2009	0	0	2	2
2009-2010	0	0	1	1
2010-2011	0	0	0	0
2011-2012	0	0	1	1
2012-2013	0	0	0	0
TOTAL	**1**	**12**	**24**	**37**

Table 2, illustrates high school female catastrophic injuries for the past 31 years – including cheerleading. High school female sports accounted for 134 direct catastrophic injuries during this time period, and 86 of those injuries were to cheerleaders. Of the 134 injuries, 4 resulted in death, 57 with permanent disability, and 73 were serious injuries with recovery. The 86 cheerleading injuries accounted for two deaths, 34 permanent disability injuries, and 50 serious injuries with recovery. High school cheerleaders accounted for 64.2% of all female sports direct catastrophic injuries. Figure 1 illustrates the number of female cheerleading injuries versus all other female sports injuries at the high school level.

Table 4 illustrates college female direct catastrophic injuries for all sports for the past 31 years. There were a total of 52 catastrophic injuries which included three deaths, 21 permanent disability injuries, and 28 serious injuries with recovery. College cheerleading was associated with 71.2% of all college female sports direct catastrophic injuries for the 30 years of data collection (one death, 12 permanent disability injuries, and 24 serious injuries with recovery). Figure 2 illustrates the number of female cheerleading injuries versus all other female sports injuries at the college level.

Following is a sample review of catastrophic injury cases collected by the NCCSIR:

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. 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. In 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. In 1990, a female high school cheerleader was thrown into the air by two other cheerleaders during a basket toss. She fell to the floor onto her neck and was in the hospital for one week. She has recovered and is back in school.

16. In 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 hospitalized and has since fully recovered.

17. In June of 1991, a 15-year-old cheerleader suffered injuries to the head during cheerleading camp. She was struck in the head by her falling partner and also hit her head on the ground. The cheerleader was taken to the hospital but her condition is not known at this time.

18. A middle school cheerleader was injured in 1991. When she fell from a double level cheerleading stance during practice. She hit her head on the gym floor and died the next week.

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. In 1993, 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 fully recover.

23. In 1993, 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.

55. In 2008 a male college cheerleader was injured in a tumbling accident and the result was quadriplegia.

56. In 2009 a high school cheerleader was injured in practice while the team was practicing a stunt and a teammate fell on her neck at least twice. She has paralysis in one of her arms.

57. This accident happened in China in 2008 when a female flyer fell to the floor during a basket toss, hit her head on a floor with no padding, and died.

58. A 16 year old female high school junior was cheering at a football game when she collapsed. CPR was administered. She was revived and taken to the hospital, but died three hours later. Cause of death was due to sudden cardiac arrest.

59. A 20 year old female college junior was completing a stunt during a game when she was flipped in the air but landed face first on the floor. There is speculation that the male cheerleader holding her in the stunt was hit by another cheerleader, causing her to fall. She was taken to the hospital but released with no serious injuries.

60. A female 14 year old high school freshman cheerleader was practicing varsity cheerleading in the school cafeteria with no padding/mats. They were practicing a "post-to-hands" stunt in which one person is the base, the other is the flyer, and the other is the spotter. Once she was lifted in the air, she lost balance and fell. The spotter was not in position and the athlete hit her head on the cafeteria floor. She suffered a fractured skull,

bleeding on her brain, and a concussion. Physical symptoms subsided after a few months but athlete complained of long-standing anxiety and depression.

61. A female 14 year old freshman cheerleader was trying out for the varsity cheerleading squad. She was warming up for a back tuck (necessary to make the squad). With another girl spotting her, she prepped for back tuck. As she fell backward, she lost her balance. The spotter was unsure of what to do. Athlete's head hit the floor and she sustained a laceration to her head and was unable to breathe. The ambulance arrived before they found someone who k CPR. She had broken her C1 & C2 vertebrae, causing her vertebra to clamp her brain stem and her heart to stop. She spent seven months in the hospital before she was released. She is paralyzed from the neck down and requires a respirator to stay alive.

62. A female high school cheerleader suffered a broken neck after falling while practicing with the junior varsity squad. She wore a neck brace for a month and made a full recovery.

Discussion

Cheerleading has changed dramatically in the past 31 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 approximately two-thirds 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 and should cheer competition be called cheerleading. Cheerleading is an activity with gymnastic type stunts. Approximately 20-25 states have a state championship for competitive cheer and it is not clear how many states consider cheerleading a sport. The 2011/12 high school participation

survey for competitive spirit squads shows 116,508 females and 3,011 males for a total of 119,519 participants. 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, but did not distinguish between competitive and other. The release stated that the 400,000 included freshman, junior varsity, and varsity levels. Sport Business Network participation numbers estimated approximately 600,000 individuals participating in cheerleading 70+ days per year (http://www.sbrnet.com/MarketResearchSummaries-Participation.asp accessed 9/28/2014). College participation numbers are hard to find since cheerleading is not an NCAA sport. The 2012/13 high school athletics participation survey show the numbers mentioned above (119,519) and since this is the official number of the NFHS this is the number that will be used for this report.

In 2012/13, there were no direct serious catastrophic injuries in high school or collegiate cheerleading. However, NCCSIR captured three direct catastrophic injuries in female high school cheerleading (2011, 2004, and 2003). It important point to note, of all direct catastrophic injuries to high school female athletes from 1982/83 to 2012/13, high school cheerleading accounted for 64.2% - over half (Table 2). This figure emphasizes the importance of safety regulations and rules for cheerleading. The state of Florida treated cheerleaders for more injuries than any other sport, and a University in Florida had an increase of insurance rates for cheerleading from $30,000 to $75,000 a year. 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. In addition, it will be important for future injury data collection to know whether it was a competitive cheer injury or regular cheer injury.

An additional area of concern in all sports, including cheerleading, is concussions. The Sports Concussion Institute in Los Angeles states that cheerleading is a sport that does not receive the attention it deserves, and they see dozens of cheerleading concussions each year. An athletic trainer in a New Jersey high school stated that cheerleading is a big deal when it comes to concussions and head injuries are an issue- especially with the competitive teams. Cheer squads should all follow the new NFHS Concussion Guidelines whether they are considered a sport or not.

An important question for sports community is: 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. 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. Cheerleading coaches should follow the concussion policy and guidelines published by the NFHS.
11. Cheerleading coaches should have some type of safety 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 (physical exams, qualified coaches, safe facility, athletic trainers, practice limits, and starting and ending dates for practice and games or competitions). 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. 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 new rules and updates are available from the National Federation of State High School Associations in Indianapolis, Indiana. Kent Summers is the contact person.

The NFHS Spirit Rules Book (2012-2013) is available from the NFHS. The NFHS Spirit Rules Book includes Points of Emphasis and one of those is a section on concussions. 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. Effective for the 2012/13 season, new rules have been added or existing rules modified to make the sport safer as a whole. These changes have approved by the NFHS Spirit Rules Committee and by the NFHS Board of Directors.

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 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). 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. 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). 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 Parent's Guide to Cheerleading Safety" which offers the five top questions parents should be asking when their child joins a school cheerleading squad (http://www.aacca.org/content.aspx?item=Resources/Parents%20Guide%20to%20Cheerleading%20Safety.xml). In May of 2010 AACCA announced new rules for elementary, middle, and junior high schools which prohibits all basket tosses and double full twisting dismounts, regardless of the surface. AACCA urges associations that govern elementary, middle, and junior high school cheerleaders to adopt these restrictions regardless of whether they follow the NFHS or AACCA Cheerleading Rules.

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. Krista Parks is the Executive Director.

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. The Foundation provided 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.

At the present time the National Cheer Safety Foundation is the leader in cheerleading safety and will soon have a coach's certification program that will also be one of the best in the country.

If it was not for the data collection system initiated by the National Center for Catastrophic Sports Injury Research, none of these organizations would be involved with the safety of cheerleading. The 31 years of catastrophic injury research indicate cheerleading comprises the majority of direct catastrophic sport injuries among the female sports presented in this report 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 the first catastrophic cheerleading injury data was collected in 1982/83. Cheerleading is an excellent activity for both males and females and ensuring proper safety measures are followed will improve the safety of this activity.

A recent article dated June 23, 2011, stated that in New Jersey legislation released by the Assembly Education Committee would include cheerleading in the student-athlete head injury

safety training program. The bill would extend the training requirement to cheerleading coaches in public and non-public school interscholastic sports programs. It continued by saying these students run a risk of serious injury when they perform and deserve the same level of protection given to other students involved in school athletics.

Figure 1. High School Direct Catastrophic Injuries among Cheerleaders Compared to All Other Female High School Sports, 1982/83 to 2012/13

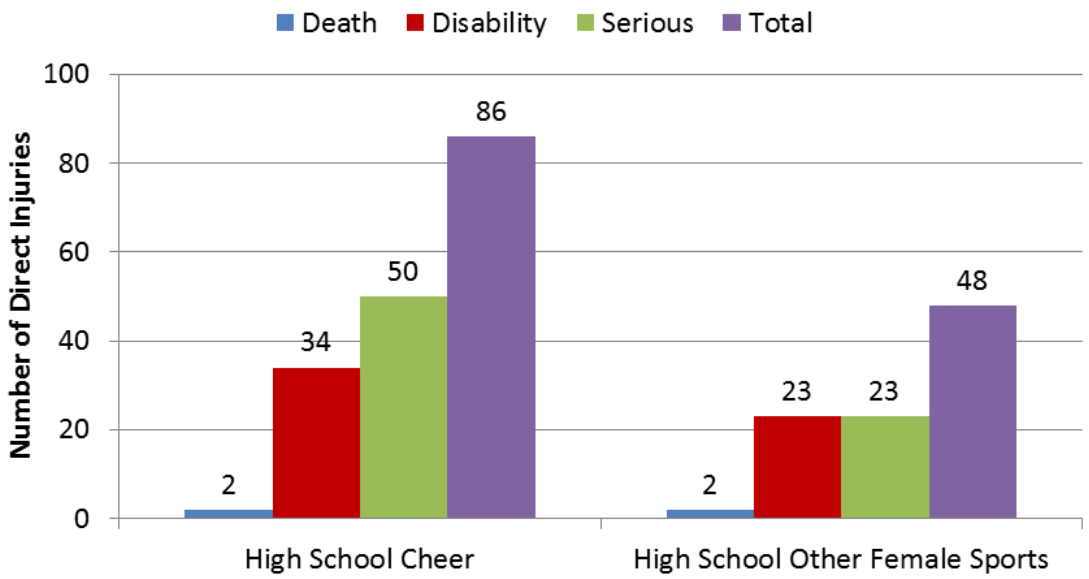
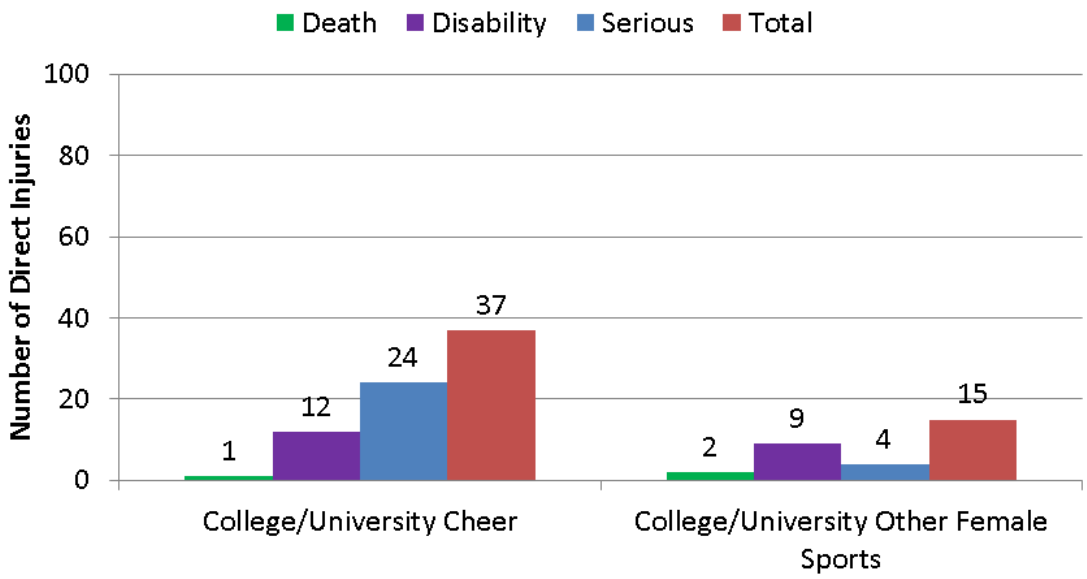


Figure 2. College Direct Catastrophic Injuries among Cheerleaders Compared to All Other Female College Sports, 1982/83 to 2012/13



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