

**CATASTROPHIC
SPORTS INJURY RESEARCH**

THIRTY-SEVENTH ANNUAL REPORT

FALL 1982 - SPRING 2019

**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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FINAL
Sep 27, 2020

Report may be downloaded here: <https://nccsir.unc.edu/reports/>
Report #: 2020-03



Acknowledgements:

We acknowledge the significant contributions of recently retired Frederick O. Mueller, Ph.D. who directed The National Center for Catastrophic Sport Injury Research (NCCSIR) from 1982 to 2013. Dr. Mueller's work during those 30 years has improved the safety of football for the participants and these impacts are demonstrated in the pages of this report.

We also acknowledge NCCSIR staff members Randi DeLong, Courtney Haley, Jeremy Mercer and members of the Consortium for Catastrophic Sport Injury Monitoring: Drs. Douglas Casa, Jonathan Drezner, Kevin Guskiewicz, Johna Register-Mihalik, Steve Marshall, Dawn Comstock, David Klossner, Tom Dompier, Zack Kerr, and Christine Collins.

We also thank all the athletes, families, coaches, athletic trainers, medical providers, school staff, state associations, researchers, journalists, and others who have participated in this research and have shared information with the NCCSIR.

Funding & Disclosures:

The National Center for Catastrophic Sport Injury Research is supported by the American Football Coaches Association (AFCA), the National Collegiate Athletic Association (NCAA), the National Federation of State High School Associations (NFHS), the National Athletic Trainers' Association (NATA), the American Medical Society for Sports Medicine (AMSSM), the National Operating Committee on Standards for Athletic Equipment (NOCSAE), and The University of North Carolina at Chapel Hill (UNC-CH).

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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 was directed for 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, University of Maryland) with expertise in head/neck, cardiac, and heat-related sports medicine (these three areas account for the overwhelming majority of catastrophic events).

To learn more about NCCSIR please visit: <http://nccsir.unc.edu/about/>

To learn more about the Consortium please visit: <http://nccsir.unc.edu/consortia-and-partners/>

To access online reports please visit: <http://nccsir.unc.edu/reports/>

METHODS

Outcome Definitions

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 is 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 traumatic (or direct) or exertional/medical (or indirect). The definition are as follows:

Traumatic injury (**direct**) - Those injuries that resulted directly from participation in the skills of the sport.

Exertional/medical (**indirect**) - Those events 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.

Note: Beginning in 2014, NCCSIR also collects non sport-related events such as sudden cardiac arrest that occurred outside of sport activity (e.g., during sleep). These events were not included in the tables but are described in the Case Summary sections.

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, email or personal letter and questionnaire was initiated with the injured player's athletic trainer, athletic director, or coach. Data collected included background information on the athlete (age, height, weight, experience, previous injury, etc.), accident information, immediate and post-accident medical care, type injury, and equipment involved. Autopsy reports are used when available. In order to improve overall capture of catastrophic sport injury and illness events, NCCSIR and the Consortium for Catastrophic Injury Monitoring in Sport developed an online portal where anyone can report a catastrophic event: <https://www.sportinjuryreport.org>. The portal was activated in January 2015.

Participation in Sport

Athletes may complete in more than one sport season. Therefore, participation is presented in athlete-seasons. Yearly participation estimates for high school athletes are obtained from NFHS participation reports (available online: <https://www.nfhs.org/ParticipationStatistics/ParticipationStatistics/>). NFHS high school annual athletic participation for 2018/19 included 7,652,585 athlete-seasons (3,240,756 female-seasons and 4,411,829 male-seasons). Yearly participation estimates for collegiate level athletes are obtained from the National Collegiate Athletic Association (NCAA) participation reports (accessed online: https://ncaaorg.s3.amazonaws.com/research/sportpart/2018-19RES_SportsSponsorshipParticipationRatesReport.pdf). NCAA participation for 2018/19 in championship sports was 499,213 athlete-seasons. There were 282,265 male-seasons and 216,948 female-seasons. There were also 3,470 males in non-championship sports (archery, badminton, bowling, equestrian, rowing, rugby, sailing, and squash) and 2,546 females participating in emerging sports (archery, badminton, equestrian, rugby, squash, synchronized swimming, team handball, and triathlon).

During the entire 37 year period from the fall of 1982 through the spring of 2019, there were 236,263,137 (94,204,301 female and 142,058,836 male) high school participant-seasons in the sports covered by this report and approximately 13,568,395 (5,433,508 female and 8,134,887 male) college participant-seasons (Table 12).

Not all high schools and colleges are members of the NFHS and NCAA. Complete data is not available for the non-member schools. Therefore, these participation numbers underestimate the total number of high school and collegiate participants in the United States.

Analysis

Frequencies and incidence rates of catastrophic injury per 100,000 athlete-seasons were calculated over the entire 37-year period and stratified by level (high school and college) and sport. Incidence rates were stratified by traumatic injury (direct) versus exertional/medical (indirect) and by severity. **Note: if there were no events in the sport for a particular year, the year is excluded from the frequency Table. Rates with number of incidents less than 5 should be interpreted with caution.**

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

Current AY2018-2019 Summary

From July 1, 2018 to June 30, 2019 there were a total of 88 catastrophic injuries/illnesses captured by NCCSIR among high school and college organized sport participants. Of these, 80 events were due to or occurred during sport-related activities (Table 11). There were also 8 catastrophic events that occurred during non-sport related activity. All were cardiac-related: 2 collegiate and 6 high school level; 1 female and 7 males.

Sport-related events: The majority of the sport-related catastrophic events (n=80) were at the high school level (78%, n=62) and among males (91%, n=73). Member institutions for the 18 collegiate cases included NCAA and junior college. Overall, 31.3% of cases were fatal, 8.8%

were nonfatal permanently disabling, 53.8% were serious with recovery, and 6.3% were unknown. Forty-six percent (n=37) were due to traumatic injury (direct) causes and half occurred in competition (48.8%) followed by practice (26.3%). The majority of events occurred to athletes participating in the following sports: football (60.0%), basketball (15.0%), soccer (3.8%), track and field (7.5%), baseball (3.8%), cross country (2.5%), lacrosse (2.5%), and water polo (1.3%). Areas of the body most commonly affected were heart (36.3%), spine (22.5%), and head/brain (16.3%). Sudden cardiac arrest (36.3%) was the most common type of events followed by heat-related injury (13.8%), brain trauma (12.5%), spine fracture (12.5%), and other traumatic injuries (11.3%).

Traumatic injury (direct) events: 8.1% of traumatic injury (direct) events were fatal, 18.9% non-fatal permanently disabling, 59.5% serious with recovery, and 13.5% unknown. A greater proportion of traumatic injury (direct) events occurred in competition versus practice (78.4% versus 10.8%) and were due to contact with another player (75.7%), apparatus/object (8.0%), or ground/surface (8.1%). The most frequent activity was tackling/being tackled (45.9%) and a large proportion were unknown (18.9%). The highest proportion was to the spine (48.6%) and head/brain (35.1%) followed by other traumatic injury (16.2%). The majority occurred in football (75.7%) followed by track and field (8.1%), soccer (5.4%) and lacrosse (5.4%).

Exertional/medical (indirect) events: 51.2% of exertional/medical (indirect) events were fatal and 48.8% were serious with recovery. There were more fatal events in 2018/19 compared to 2017/18 (51% n=22 versus 35% n=16). The majority occurred during practice (39.5%) followed by competition (23.3%), conditioning sessions and weight training sessions (23.2%), and unaffiliated recreational activity (11.6%). The most frequent activity was conditioning (25.6%) and a large proportion were unknown (11.6%). The majority were cardiac-related (67.4%) and heat-related (25.6%). There were more heat-related events in 2018/19 compared to the previous year 2017/18 (25.6% n=11 versus 15% n=7). Football (46.5%) and basketball (25.6%) comprised the majority followed by track and field (7.0%), and baseball and cross country (4.7% each).

Overall Summary

During this 37-year period, there were 2776 catastrophic sport-related injuries/illnesses at high school and college levels (Table 1 – excluding cheerleading, drill team, and rodeo there were 2,655). The majority were non-fatal (62%) and from traumatic or direct mechanisms (64%), and among high school participants (80%). The proportion of fatal (38% versus 36%) and traumatic injury (direct) (64% versus 61%) were not different by high school compared to college level.

The 80 sport-related catastrophic injuries and conditions captured in 2018/19 is not different from the previous two years (85 in 2017/18 and 80 in 2016/17) and a 25% decrease from 2015/16—a result of a lower number of traumatic brain and cervical spine/spinal cord injuries in the last three years. *Note: see limitations regarding the interpretation of this percentage difference.*

Traumatic Injuries (Direct) by Sport: For high school sports, football had the highest *number* of traumatic injury (direct) catastrophic events, followed by female cheerleading, wrestling, baseball, and male track and field (Table 4a). Accounting for the number of participants in the sport, male and female cheerleading, male gymnastics, football, and male ice hockey had the highest rates per 100,000 participant-seasons (Figure 2, Table 9a). When restricted to fatal events male gymnastics, football, male ice Hockey, and female skiing had the highest rates per 100,000 participant-seasons (Figure 1).

For college sports, football had the highest *number* of traumatic injury (direct) catastrophic events, followed by female cheerleading, baseball, and male track and field (Table 5a). Accounting for the number of participants in the sport, male gymnastics, female skiing, football, male ice hockey, male skiing, female equestrian and female gymnastics had the highest rates per 100,000 participant-seasons (Figure 4, Table 9b). Similar results were observed when restricted to fatal events female skiing, male skiing, equestrian, male lacrosse, and male rowing had the highest rates per 100,000 participant-seasons (Figure 3).

Exertional/Medical Conditions (Indirect) by Sport: For high school sports, football had the highest *number* of exertional/medical (indirect) catastrophic events, followed by male basketball,

male track and field, male soccer, wrestling, baseball, and male cross country (Table 4b). Accounting for the number of participants in the sport, rowing, male basketball, football, male ice hockey, male water polo, and male lacrosse had the highest rates per 100,000 participant-seasons (Figure 2, Table 10a). When restricted to fatal events male basketball, football, male water polo, male lacrosse, and male ice hockey had the highest rates per 100,000 participant-seasons (Figure 1).

For college sports, football had the highest *number* of exertional/medical (indirect) catastrophic events, followed by male basketball, wrestling, female basketball, baseball, male soccer, and male swimming (Table 5b). Accounting for the number of participants in the sport, male basketball, male water polo, male skiing, football, male wrestling, male ice hockey, male swimming, and male rowing had the highest rates per 100,000 participants (Figure 4, Table 10b). When restricted to fatal events male basketball, male water polo, male skiing, football, male swimming, male rowing, male wrestling had the highest rates per 100,000 participants (Figure 3).

DISCUSSION

The following strengths and limitations should be noted:

- Data have been collected by The National Center for Catastrophic Sport Injury Research for all high school and college sports since 1982 using consistent definitions and methodology over a 30+ year period. These data are provided annually to sport organizations (NCAA, NFHS, AFCA), researchers and the public. Sports medicine advisory committees, sport rules committees, and coaching committees review the reports and have used these data to inform and evaluate safety recommendations, medical care, and rule changes.
- Catastrophic events are primarily captured through publicly available media reports. Therefore, not all catastrophic events are captured. Particularly, for non-fatal catastrophic events, which may not be reported in the media as comprehensively as fatalities. Under-reporting may also be due to outcome definitions used (e.g. timing of

the event) and event locations (e.g. at home, personal conditioning). **In order to improve overall capture of these events, NCCSIR and the Consortium for Catastrophic Injury Monitoring in Sport have developed an online portal where anyone can report a catastrophic event: <https://www.sportinjuryreport.org>.** The online portal was activated in January 2015. Any observed changes in annual number of events may be attributed to these described improvements in data collection methods.

- Details surrounding catastrophic events that are only captured through publicly available media reports may not be completely accurate in the absence of the actual autopsy or medical reports.
- Incidence rates were calculated using participation estimates from NFHS and the NCAA in the rate denominator (Table 12). These participation estimates do not include schools that are not members of these two associations. Participation data were not available for these non-member schools. At present NFHS and NCAA are the only estimates available. Therefore, the participation numbers (rate denominator) in this report are underestimated, which results in an overestimate of the actual incidence rate.
- It is important to note that catastrophic events are rare and statistical power for some strata comparisons are limited. Rates with number of incidents less than 5 should be interpreted with caution.

RECOMMENDATIONS

1. Each athlete should have a complete physical examination with a medical history and an annual health history update.
2. All personnel involved with training athletes should emphasize proper, gradual, and sport-specific physical conditioning.
3. Every school should strive to have a certified athletic trainer.
4. Each school should have a written emergency action plan (EAP) in place, all personnel should have copies, and procedures should be reviewed and practiced annually.
 - The Centers for Disease Control and Prevention (CDC) has guidelines and templates for these plans (<http://www.cdc.gov/niosh/docs/2004-101/emrgact/emrgact1.html>).
 - NCAA and the NFHS have guidelines for these plans at the following websites: www.nfhs.org and www.ncaa.org.

- **An automated external defibrillator (AED) should be available and accessible onsite and medical and coaching staff should be trained in the use.**
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. 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.
 9. There should be continued surveillance and safety research in athletics (rules, facilities, equipment, medical care and procedures).
 10. **Sudden cardiac arrest:** The number of exertional/medical (indirect) cardiac related events has increased over the years and it is recommended that schools have and emergency action plan and automated external defibrillators (AED) available and accessible on-site for emergency situations. Early detection and defibrillation is critical for survival (3-5 minutes recommended). (Casa et al. 2012)
 - See also Drezner et al. 2007 for additional information about sudden cardiac arrest preparedness and management: <http://www.nata.org/sites/default/files/sudden-cardiac-arrest-consensus-statement.pdf>
 11. **Heat-illness:** All personnel associated with sport participation should be cognizant of the safety measures related to physical activity in hot weather. Heat stroke and heat exhaustion are prevented by careful control of various factors in the conditioning program of the athlete.
 - The NATA has a heat illness position statement on their web site (<https://www.nata.org/news-publications/pressroom/statements/position>) with recommendations for prevention: Casa et al. 2015

(<http://natajournals.org/doi/pdf/10.4085/1062-6050-50.9.07>) and Casa & Cisllan, 2009 (<http://natajournals.org/doi/pdf/10.4085/1062-6050-44.3.332>)

- Coaches, athletic trainers, and players should refer to the multiple published best practices by the NATA, American College of Sports Medicine (ACSM), NFHS, and NCAA on preventing and managing heat illness. Emergency action plans should be activated.
- Link to the NFHS Sport Medicine Advisory Committee Position Statements: <https://www.nfhs.org/sports-resource-content/nfhs-sports-medicine-position-statements-and-guidelines/>
- Link to handout from the NATA on Heat Illness: <http://www.nfhs.org/media/1015650/2015-nata-heat-illness-handout.pdf>
- Link to handout from the Kory Stringer Institute on exertional heat stroke prevention: <https://ksi.uconn.edu/wp-content/uploads/sites/1222/2018/01/Preventing-Surviving-EHS-September-2017.pdf>

12. **Head Trauma:** When a player has shown signs or symptoms of head trauma (such as a change in the athlete's behavior, thinking, or physical functioning), the player should receive immediate medical attention from an appropriate medical provider and should not be allowed to return to practice or game that day. The athlete should not be allowed to return to practice or game without an evaluation by an appropriate medical provider.

- 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 and their concussion policies: <https://www.cdc.gov/headsup/policy/index.html>
- For the most up to date information on concussion management please see the updated Consensus Statement on Concussion in Sport: The 5th International Conference on Concussion in Sport held in Berlin, October 2016 (McCrory et al. 2017 available at <http://bjsm.bmj.com/content/51/11/838>).
- Some cases associated with brain trauma reported that players complained of symptoms or had a previous concussion prior to their deaths. The team physician, athletic trainer, or coach should ensure players understand signs and symptoms of concussion and brain trauma. Players should also be encouraged to inform the team

physician, athletic trainer, or coach if they are experiencing any of the signs or symptoms of brain trauma outlined by the CDC.

- **HEADS UP ON CONCUSSION IN SPORTS:**

Information for Parents, Coaches, and School & Sports Professionals. Available at:

<http://www.cdc.gov/headsup/highschoolsports/index.html>

The NFHS Sport Medicine Advisory Committee has developed guidelines for concussion management in sports: <http://www.nfhs.org/media/1014737/suggested-guidelines-for-management-of-a-concussion-in-sports-october-2013-2.pdf>

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 which may be found at: <http://www.ncaapublications.com/>

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.

13. **Spinal injuries:** Early recognition, prompt medical evaluation and management of cervical cord and spine injuries is critical for preventing permanent disability and death. Certified athletic trainers are trained to recognize and manage these injuries and whenever possible should be present for all football practices and games. Best practices recommendations for pre-hospital spine injury emergency management in football were updated in 2020 (Courson et al. 2020). For the most up to date information on management and prevention of these injuries see the following websites:

- National Athletic Trainers Association: <https://www.nata.org/practice-patient-care/health-issues/spine-injury>
- The Spine Injury in Sport Group is comprised of 25 medical bodies and sport organizations and published best practice guidelines for prehospital care and management of football players with suspected spine injuries: <https://meridian.allenpress.com/jat/article/55/6/545/438481/Best-Practices-and-Current-Care-Concepts-in>.
- Kory Stringer Institute: <https://ksi.uconn.edu/emergency-conditions/cervical-spine-injury/>

14. **Internal Organ Injuries:** Like cervical cord and spinal injuries, early recognition and prompt medical evaluation and treatment of internal organ injuries is critical for ensuring the best possible outcome. Emergency action plans, access to certified athletic trainers, and on-site medical services for competitions constitute best practices for these injuries. A better understanding of the activities and mechanisms associated with these injuries and use of protective gear worn is needed for prevention. Wearing protective gear (e.g., padded belt or shirt) that extends beyond the bottom of the shoulder pads to cover the torso may protect internal organs from direct contact.

15. **Lightning-Related Injuries:** Lightning-related injuries can happen during severe weather. In 2018, there were 20 documented lightning-related deaths and 82 nonfatal injuries among the general population in the United States (Insurance Information Institute, n.d.; National Weather Service, 2019). July and August have the highest risk for lightning strike-related injury. A majority of lightning-related deaths are associated with outdoor recreation (Thomson & Howard, 2013). An athlete struck by lightning may suffer traumatic injuries and sudden cardiac arrest. Prevention measures include monitoring weather conditions and moving to a designated safe location until the threat has passed. This is not only important for athletes, but also for spectators.

CASE SUMMARIES AY2018/19

**Compiled from available media reports (n=80 events captured by NCCSIR).*

COLLEGE/UNIVERSITY

Baseball Exertional/medical (indirect)

A male 21 year old collegiate baseball player collapsed on the field during baseball practice. He was transported to a nearby hospital but could not be revived. Cause of death is pending autopsy but is suspected to be cardiac related.

Basketball Exertional/medical (indirect)

A male 21 year old collegiate senior basketball guard collapsed following a pick-up basketball game with friends. Efforts to revive him were unsuccessful. Cause of death was cardiomyopathy.

A male 24 year old collegiate basketball player collapsed following a pick-up basketball game. Bystanders transported him to a nearby hospital. He was not able to be revived. Cause of death is pending autopsy but is suspected to be cardiac related.

A male 21 year old collegiate basketball player collapsed during a timeout in a basketball game. The athletic trainer was giving him water when he slumped and fell to the side, then began to seize. He was attended to an athletic trainer, nurse and other medical staff until emergency personnel arrived. The athletic trainer and nurse put him on oxygen, started CPR on the basketball court, and used the AED until EMS arrived and took over. The athlete regained a pulse on-scene and was transported to a nearby hospital. He never fully regained consciousness and passed away a week later. Cause of death was arrhythmogenic right ventricular cardiomyopathy (ARVC).

Cross Country Exertional/medical (indirect)

A male collegiate cross country runner collapsed during practice. He was transported to a hospital and later diagnosed with heat stroke and rhabdomyolysis. A full recovery is expected.

Football Traumatic injury (direct)

A male 20 year old collegiate football linebacker was injured during a football game. He came off the field complaining of a headache and was placed into concussion protocol. While heading toward the locker room for treatment, he collapsed. On site EMS personnel transported him to a hospital. He underwent emergency brain surgery. A full recovery is expected.

A male 19 year old collegiate sophomore football offensive lineman was injured during a football game. He was injured during a tackle and was immediately unable to move his legs. He is currently paralyzed from the waist down and is recovering in a long term facility. A long term prognosis is unknown.

A male collegiate football player was injured attempting to make a tackle during a football game. The athlete was attended to on-field and airlifted to a hospital. He underwent emergency surgery for a fractured C5 vertebra. He will graduate from college though he can no longer play football. Long term prognosis is unknown.

Football Exertional/medical (indirect)

A male 18 year old collegiate freshman football defensive back collapsed during a preseason conditioning session. The coach called 911 and he was immediately attended to by athletic trainers. An EMS crew arrived and continued care, but all revival efforts were unsuccessful. Cause of death was acute aortic dissection.

A male 19 year old collegiate football defensive tackle was found medically distressed outside his dorm room following the team's first practice. He was tended to by an athletic trainer until EMS arrived. He was transported to a nearby hospital where he later died. Cause of death was exertional heat stroke.

A male 20 year old collegiate football player collapsed while exercising at home from cardiac arrest. He was taken to a hospital but was unable to be revived and passed away two days later.

A male 23 year old collegiate football player died following a hospitalization for hyponatremia. The athlete injured his upper leg at football practice, was treated with ice and stayed on the sidelines the remainder of practice, and later went to the hospital with muscle pain and spasms. His sodium levels had dropped dangerously low, and he was diagnosed with hyponatremia. His condition worsened, causing seizures and brain swelling and athlete died after three days in the hospital.

A male 18 year old collegiate football player suffered exertional heat stroke during a football conditioning session. The athlete started cramping and feeling faint and was placed in cold water immersion for 45 minutes. A full recovery is expected.

A male 18 year old collegiate football player suffered exertional heat stroke during a pre-season football conditioning session. After completing the workout, he felt woozy and fainted. Athlete was transported to the hospital. A full recovery is expected.

A male 19 year old defensive lineman suffered heat stroke during practice. The athlete suffered from full body pain and cramping with muscle movement. The athlete was taken to a hospital. Current prognosis is unknown.

Other Exertional/medical (indirect)

A male 21 year old collegiate football player collapsed and hit his head while practicing step dancing with friends. He began convulsing and foaming at the mouth. He was then transported by friends to a hospital but was not able to be revived. The cause of death was cardiac arrhythmia due to cardiomegaly.

Soccer Traumatic injury (direct)

A female 21 year old collegiate senior soccer player sustained a skull fracture during a soccer game by colliding with another player while attempting to head the ball. The athlete made a full recovery.

Track and Field Traumatic injury (direct)

A male collegiate track and field athlete was doing a warm-up exercise when he backed into a javelin sticking out of the ground. The athlete was transported to the hospital via EMS where he had surgery for a punctured and collapsed lung. He is expected to make a full recovery.

HIGH SCHOOL

Baseball Traumatic injury (direct)

A male high school baseball pitcher was struck by a line drive on the left side of his head. He was knocked unconscious and attended to by athletic trainers and coaches. He was transported to a hospital by ambulance. The athlete suffered a fractured temporal bone, brain bleed, and a concussion. Current prognosis is unknown.

Baseball Exertional/medical (indirect)

A high school baseball pitcher suffered sudden cardiac arrest while pitching in the fourth inning. The athlete was attended to by a coach, an athletic trainer, and a physician. AED and CPR were used until EMS arrived. The athlete was transported to a hospital and the athlete remains in serious condition.

Basketball Traumatic injury (direct)

A male high school basketball player sustained a traumatic brain injury during a game. The athlete went for a dunk and his legs swung out from under him, causing him to fall backwards and land on the back of his head and neck. The athlete was stabilized on-court and transported to a hospital. He was placed in a medically induced coma until brain swelling subsided. A long but full recovery is expected.

Basketball Exertional/medical (indirect)

A female 18 year old high school senior basketball player collapsed during basketball practice. EMS were called and she was transported to a nearby hospital where she later died. Cause of death is pending autopsy but is suspected to be cardiac related.

A male 17 year old high school basketball player collapsed following a pick-up basketball game. He was transported by EMS personnel to a hospital where he was later pronounced dead. Cause of death was due to cardiomyopathy.

A male 16 year old high school basketball player collapsed during basketball practice. His coaches immediately called 911 and he was transported to a hospital where he was pronounced dead. Cause of death was from an unspecified cardiac condition.

A male 16 year old high school basketball player collapsed during a basketball game. He was sitting on the bench when he suddenly collapsed. He was attended to by EMS personnel and transported to a hospital. He was pronounced dead that night. Official cause of death is pending autopsy but is suspected to be cardiac related.

A male 16 year old high school basketball player collapsed during halftime of a basketball game. A bystander nurse performed CPR until paramedics arrived and took over CPR and applied an AED. He was transported to a nearby hospital and later died.

A male 16 year old high school basketball player collapsed during basketball practice. He complained of feeling lightheaded and collapsed shortly afterwards. He was transported to a hospital but was unable to be revived. Cause of death was cardiac arrest due to congenital abnormality of the right coronary artery.

A male 16 year old high school basketball player suffered from a heat stroke during an outdoor pre-season basketball conditioning workout. The athlete collapsed during the workout and was attended to by on-site athletic trainers. A rectal temperature was determined to be 107.9 degrees. On site, athlete was cooled using the tarp assisted cooling (TACO) method. EMS arrived and athlete was transported to the hospital once his temperature had dropped to 103.5 degrees. A full recovery is expected.

A male 15 year old high school basketball player collapsed on the court during a practice at the school. He had been on the court for about 30 seconds. Coaches and a school nurse used CPR and AED shock to revive him. He currently has an internal defibrillator which allows him to continue playing basketball. He was also a member of the high school football team and will no longer be playing football per a doctor's recommendations.

Cross Country Exertional/medical (indirect)

A female 17 year old high school senior cross country runner collapsed during a meet. Towards the end of the race, she collapsed and started seizing before going into cardiac arrest. She was attended to by on-site medical personnel before being transported to a hospital. She was not able to be revived. Cause of death is pending autopsy.

Dance Exertional/medical (indirect)

A female 17 year old high school dancer collapsed during a team workout while running on the track. She was taken to a hospital by ambulance where she was pronounced dead. Cause of death was cardiac dysrhythmia, due to an anomaly of the left coronary artery.

Football Traumatic injury (direct)

A male high school senior football defensive back suffered a spinal cord injury while making a tackle during a scrimmage. The athlete was immediately attended to by the opposing team's athletic trainer, who provided care until EMS arrived. He was transported to a hospital where he was diagnosed with fractured C1 and C2 vertebra. He underwent spinal stabilization surgery. The athlete is currently paralyzed from the neck down.

A male high school senior football cornerback was injured making a tackle in a football game. He was transported to a hospital and underwent emergency surgery for a brain bleed. A full recovery is expected.

A male high school football player suffered a head injury during a football game. He was knocked out during a kickoff return and began convulsing. He was transported to a hospital by EMS personnel. A long term prognosis is unknown.

A male high school football cornerback was injured making a tackle during a football game. He was attended to by an on-field athletic trainer and then transported to a hospital. He was diagnosed with two fractured vertebrae in his neck and underwent emergency surgery to have five screws inserted to stabilize his neck. A full recovery is expected.

A male 16 year old high school football player was injured in a football jamboree. He felt tingling in his extremities after making a tackle. The pain worsened over the following days and he went to a hospital. He was diagnosed with a fractured C6 vertebra and underwent emergency surgery. A full recovery is expected.

A male high school football player was injured during a football game. He was tackled catching a pass and injured his knee. The following day he was diagnosed with a knee dislocation, tibial plateau fracture, and popliteal artery obstruction. The injuries required amputation of the lower portion of the lower leg. The athlete is recovering and adjusting to prosthetics.

A male high school football player fractured a vertebra in his neck being tackled during a football game. He did not require surgery but was placed in a back brace. A full recovery is expected.

A male high school football linebacker was injured during a football game. He fractured a vertebra in his neck and has an incomplete spinal cord injury. He is currently paralyzed.

A male high school football junior varsity running back was injured during a football game. He suffered thoracic spine fracture, spinal bruise, and fractured ribs. The athlete underwent surgery

to correct the damage. He is currently paralyzed below the waist but is starting to regain feeling. A long term prognosis is unknown.

A male 16 year old high school sophomore football player sustained an injury during a football game. He was immediately taken to a hospital and underwent surgery to stabilize the fractured C 3,4,5 vertebrae. He is currently paralyzed from the neck down but has been regaining feeling in his extremities. Long term prognosis is unknown.

A male 16 year old high school football linebacker was injured during a football game. After attempting to make a play, he reported a problem with the feeling in his leg. He was assisted to the sideline and attended to by an athletic trainer and an orthopedic surgeon. He later collapsed and was transported by EMS to a hospital where he underwent emergency brain surgery. He passed away two days later as a result of his injuries. Cause of death was cardiac arrest as a result of a traumatic brain injury.

A male high school senior football quarterback was injured during a football game. He was blindsided by a tackle and was unable to get up. He was taken to a hospital and was diagnosed with spinal shock. With physical therapy, he has regained movement. Prognosis is unknown.

A male 16 year old high school sophomore football player was injured during a football game. He was attempting to make a tackle when his head made contact with an opposing player's hip. He was taken to a hospital where he underwent emergency surgery for a subdural hematoma with a midline shift. Long term prognosis is unknown, but he is recovering well.

A male high school football player was injured during a football game, causing him to lose movement and sensation in his body. He was airlifted to a hospital and diagnosed with a spinal cord contusion. He regained feeling and prognosis is unknown.

A male high school junior football player sustained an injury during a football game. He was injured while making a tackle during a kickoff-return. The athlete was transported to a hospital and diagnosed with a fractured C1 and C6 vertebrae. His injuries did not require surgery and the athlete is recovering at home. Long term prognosis is unknown.

A male 16 year old high school football defensive back died as the result of injuries sustained during a football game. He fractured his C1 and C4 vertebrae when attempting to make a tackle. After the play, he was life flighted to a hospital and placed on a ventilator. He was not able to be taken off of the ventilator and passed away a week later.

A male 15 year old junior varsity football running back was injured during a football game. He was struck in the thoracic spine with an opponent's knee and fell to the ground. He complained of weakness, pain, and paralysis in the extremities but symptoms resolved on field. When the athlete had imaging done, cervical spinal stenosis was discovered. The athlete is no longer allowed to compete in contact sports.

A male high school football player collapsed on the sideline during a football game. He was immediately attended to by athletic trainers and EMS personnel before being transported to a

hospital. He immediately underwent emergency brain surgery to relieve pressure and stop a hemorrhage. Athlete has fully recovered but cannot play football.

A male 16 year old high school senior football safety (varsity) sustained an injury during a football game. He was injured attempting to tackle the opposing team's running back when his face mask collided with the player's hip. After being evaluated by an athletic trainer and team doctor, he was transported to a hospital by his mother. There he underwent surgery to remove a fractured C5 vertebrae. He can no longer play contact sports and long term prognosis is unknown.

A male 17 year old high school football player suffered a traumatic brain injury during a football practice. He was injured during a helmet-to-helmet hit. He was attended to by athletic personnel and then airlifted to a nearby hospital. The athlete remained in a coma for weeks and is still recovering. A long term prognosis is unknown.

A male high school football linebacker collapsed during a football game. The athlete had just come to the sideline when he collapsed. He was attended to by medical personnel and transported to a nearby hospital and diagnosed with a subdural hematoma. No surgery was required, and a full recovery is expected.

A male 17 year old high school junior football player was lifting weights at school when an aneurysm in his brain burst. He died as a result of the event.

A male 16 year old high school football player was injured during a football game. During a kick-off return he was blindsided by a tackle. The athlete was taken to the hospital and was diagnosed with a lacerated spleen. A full recovery is expected.

A male high school freshman football player sustained a head injury during a 7-on-7 football scrimmage. The athlete lost his footing going in for a tackle, causing his head to collide directly with the opposing player's knee. He was not wearing protective headgear at the time of the injury. He was transported by EMS to a hospital and underwent emergency surgery. The injury caused a compressed skull fracture, life-threatening swelling, and a brain clot. The surgery was successful but long term prognosis is unknown.

A male high school football player was tackled during a game and was in immediate pain. The athlete was taken to a hospital and diagnosed with three fractured vertebrae in his lower back. The athlete made a full recovery.

Football Exertional/medical (indirect)

A male 16 year old high school junior football lineman collapsed at the end of a conditioning workout. EMS personal attempted to revive him but were unsuccessful. The cause of death was determined to be from hypertrophic cardiomyopathy.

A male 15 year old high school football offensive lineman experienced heat stroke during a preseason conditioning session. He was attended to by athletic trainers and placed in an

immersion ice tub until EMS arrived and transported him to an area hospital. A full recovery is expected.

A male 15 year old high school football lineman collapsed during a football conditioning session due to severe dehydration and kidney failure. He was revived on site by medical personnel and then transported by EMS to a hospital. The athlete continues to suffer from kidney problems and has been placed on dialysis.

A male 15 year old high school junior varsity football offensive lineman complained of severe chest pain following a football game. He was transported by EMS to a hospital where he later died. Cause of death is pending autopsy but is suspected to be cardiac related.

A male high school football junior linebacker collapsed during a football game and suffered sudden cardiac arrest. He was attended to by athletic trainers and revived on field from CPR and an AED. He was transported to a hospital and is expected to make a full recovery.

A male 16 year old high school sophomore football running back collapsed during a football game. He was walking towards the sideline during a timeout when he collapsed and went into cardiac arrest. He was immediately attended to by bystander physicians, an athletic trainer, and first responders, who performed CPR and applied an AED. The AED was 30 feet away from the athlete at the time of collapse. He was revived on-field after one shock but had a seizure after. EMS arrived after about 20 minutes and transported him to the hospital. He was diagnosed with a left coronary artery anomaly and underwent coronary bypass surgery 10 days after the incident. The athlete made a full recovery and continues to be active in sports.

A male 16 year old high school junior football quarterback collapsed during football practice. He was attended to by coaches who were able to revive him on field. He was transported to the hospital where it was determined that the cardiac arrest was caused by a right bundle branch blockage. A full recovery is expected.

A male 15 year old high school football player suffered an exertional heat stroke during football practice. He was treated with ice bags on the field and then placed in a cold shower. He became unresponsive and was transported to a hospital, where his internal temperature was 106F. He was temporarily placed on a ventilator. A full recovery is expected.

A male 16 year old high school football player collapsed while conditioning in the weight room at the high school. He was transported to a hospital by EMS where he died about an hour later. Cause of death was determined to be probable cardiac dysrhythmia in an individual with ventricular hypertrophy.

A male 14 year old freshman suddenly collapsed 20 minutes into conditioning drills. He was attended to by EMS and transported to a nearby hospital where he later died. His body temperature when he arrived at the hospital was 102 degrees. Cause of death was due to exertional hyperthermia (heat stroke). Contributing factors included cardiac hypertrophy and hypernatremia.

A male 15 year old football player collapsed in the locker room following a late night practice. EMS crews administered CPR and were able to get a pulse, before transporting him to a hospital. He was pronounced dead shortly after arrival at a hospital. Cause of death is pending autopsy but is suspected to be cardiac related.

A male high school football player began showing signs of distress toward the end of a summer workout. He was immediately transported to the hospital by his father. The athlete suffered from heat stroke and, he was placed in the ICU. Current prognosis is unknown.

A male 14-year old high school football athlete collapsed while running sprints during football workouts after going into cardiac arrest. He was immediately attended to by the coach and received CPR. He also received 2 shocks from the AED. The athlete was transported to a hospital by ambulance and was placed on a ventilator. He has an internal defibrillator and is cleared to play sports again.

Lacrosse Traumatic injury (direct)

A male 16 year old high school lacrosse player was injured during a lacrosse game. He was hit in the back of the neck and fell to the ground unable to move. He was transported to a hospital and diagnosed with an incomplete spinal cord injury and a herniated disc. He underwent emergency surgery and regained full movement and sensation.

A male high school junior lacrosse athlete suffered an injury during a game. He collided with an opponent, lowering his head for the collision. He immediately fell. The on-site athletic trainer tended to him on the field. The athlete had multiple neck fractures and is permanently paralyzed from the chest down.

Lacrosse Exertional/medical (indirect)

A male 16 year old high school lacrosse athlete collapsed while running laps outside the high school during ROTC class. The school's head football coach and the ROTC instructor helped administer CPR and used the AED. The athlete was revived after the second electrical shock. He was taken to the hospital by EMS and is recovering at the hospital.

Soccer Traumatic injury (direct)

A female 16 year old high school soccer player was injured during a soccer game. She took a knee to the jaw that threw her head backward. She was immediately unable to move and lost sensation in her extremities. Once at the hospital she was diagnosed with severe spinal shock. She has regained movement and most sensation in her extremities.

Soccer Exertional/medical (indirect)

A female 14 year old high school soccer goalie collapsed during soccer practice. The athlete was running sprints when she began to feel dizzy and then collapsed. A coach performed CPR and

applied an AED, and the athlete was revived on scene. The athlete was taken to a hospital, but the cause of the cardiac arrest is unknown.

Track and Field Traumatic injury (direct)

A male high school track and field athlete fell on his head while pole vaulting at practice. He was conscious after the fall but then began to go in and out of consciousness in an ambulance while being transported to a hospital. The athlete suffered a skull fracture and underwent surgery. He was able to move his extremities following surgery. Current prognosis is unknown at this time.

A high school track and field athlete was walking during practice when a gust of wind pushed a javelin in flight towards him. He was struck by the javelin in the right shoulder and upper chest. The athlete was airlifted to the hospital and treated for a collapsed lung. He made a full recovery.

Track and Field Exertional/medical (indirect)

A female 16 year old high school track and field high jumper was injured during practice. In the process of getting off of a mat she fell backwards and her back hit the metal standard pole. She was transported by EMS to a hospital and diagnosed with fractured L3 and L4 transverse processes. Current prognosis is unknown.

A male high school sophomore track athlete was running the one mile race at a meet when he collapsed at the finish line. Athletic trainers at the meet used an AED on site to shock his heart back into rhythm, then he was flown to the hospital. He suffered cardiac arrest but is expected to make a full recovery and will sit out the rest of the season.

A high school male track and field runner was feeling nauseous and had difficulty breathing during a track meet. He ran two relay races and collapsed at the finish line of the second. He had chest pain and did not notify the coach right away. The next morning, the athlete received an x-ray and then went to track practice. While at practice, he was notified that he had a collapsed lung and immediately went to the hospital to undergo a procedure to inflate his lung. He had another procedure the next day. He was temporarily bound to a wheelchair but is now active in running and hopes to continue his running career in college.

Water Polo Exertional/medical (indirect)

A 16 year old female water polo athlete collapsed poolside during practice. Coach and lifeguard responded to the athlete, who was not breathing, and performed CPR. A police officer joined the CPR efforts before EMTs and firefighters arrived after just 3 minutes. The ride to the hospital took 23 minutes. Three days later, the athlete underwent surgery, where it was discovered that she has a condition called ALCAPA (anomalous left coronary artery from the pulmonary artery) syndrome. The open-heart surgery showed signs of prior trauma, unknown to the athlete. She has returned to school but has restrictions on activity and is required to take medications. She plans to return to water and competitive sports.

NOT SPORT-RELATED (n=8 events)

COLLEGE/UNIVERSITY

A male 20 year old track and field athlete was found dead in his dorm room. Cause of death was determined to be cardiac arrhythmia.

A male 18 year old collegiate freshman wrestler died in his sleep due to an enlarged heart.

HIGH SCHOOL

A male 18 year old high school baseball player collapsed suddenly while on a camping trip with friends. He was having trouble breathing and then lost consciousness. He was transported to a hospital but could not be revived. Cause of death was restrictive cardiomyopathy.

A male 16 year old high school senior basketball player passed away in his sleep. Cause of death was cardiopulmonary arrest due to an enlarged heart.

A male 16 year old high school basketball player collapsed from sudden cardiac arrest in his home. He was taken to a hospital but had suffered damage from oxygen deprivation and was not able to be revived. The athlete died four days later.

A male 18 year old high school basketball player died following a brief hospitalization due to a heart condition. Cause of death is pending autopsy.

A male 17 year old high school student-basketball manager and football player collapsed in the hallway after the basketball team returned from an away game. Two coaches performed CPR and administered a defibrillator until EMS arrived. The athlete is out of the hospital and recovering.

A female 18 year old high school senior softball player collapsed walking into school. She was attended to by faculty and a school nurse but could not be revived. Cause of death was a blood clot in her lungs.

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Table 1: Number of All catastrophic traumatic injuries (direct) and exertional/medical conditions (indirect) by year: All sports combined, all levels (high school and college)

	Collegiate/		High School		All	
	N	%	N	%	N	%
1982-1983	11	18.0%	50	82.0%	61	100.0%
1983-1984	13	21.0%	49	79.0%	62	100.0%
1984-1985	9	17.6%	42	82.4%	51	100.0%
1985-1986	16	27.6%	42	72.4%	58	100.0%
1986-1987	18	25.7%	52	74.3%	70	100.0%
1987-1988	15	17.9%	69	82.1%	84	100.0%
1988-1989	17	23.0%	57	77.0%	74	100.0%
1989-1990	11	14.5%	65	85.5%	76	100.0%
1990-1991	15	24.2%	47	75.8%	62	100.0%
1991-1992	11	23.4%	36	76.6%	47	100.0%
1992-1993	9	15.0%	51	85.0%	60	100.0%
1993-1994	11	16.9%	54	83.1%	65	100.0%
1994-1995	12	23.5%	39	76.5%	51	100.0%
1995-1996	8	15.4%	44	84.6%	52	100.0%
1996-1997	9	13.6%	57	86.4%	66	100.0%
1997-1998	15	20.0%	60	80.0%	75	100.0%
1998-1999	10	12.8%	68	87.2%	78	100.0%
1999-2000	9	12.9%	61	87.1%	70	100.0%
2000-2001	17	24.6%	52	75.4%	69	100.0%
2001-2002	14	17.3%	67	82.7%	81	100.0%
2002-2003	16	25.8%	46	74.2%	62	100.0%
2003-2004	18	24.3%	56	75.7%	74	100.0%
2004-2005	10	14.7%	58	85.3%	68	100.0%
2005-2006	12	21.8%	43	78.2%	55	100.0%
2006-2007	13	17.3%	62	82.7%	75	100.0%
2007-2008	15	18.3%	67	81.7%	82	100.0%
2008-2009	17	15.7%	91	84.3%	108	100.0%
2009-2010	27	27.6%	71	72.4%	98	100.0%
2010-2011	16	20.8%	61	79.2%	77	100.0%
2011-2012	17	21.0%	64	79.0%	81	100.0%
2012-2013	15	31.3%	33	68.8%	48	100.0%
2013-2014	18	22.0%	64	78.0%	82	100.0%
2014-2015	16	19.3%	67	80.7%	83	100.0%
2015-2016	20	18.9%	86	81.1%	106	100.0%
2016-2017	24	30.0%	56	70.0%	80	100.0%
2017-2018	20	23.8%	64	76.2%	84	100.0%
2018-2019	18	22.5%	62	77.5%	80	100.0%
Total	542	20.4%	2113	79.6%	2655	100.0%
Total*	577	20.8%	2199	79.2%	2776	100.0%

*Includes Cheerleading, Drill Team, Rodeo

Table 2: Number of Traumatic (direct) catastrophic injuries by year: All sports combined, all levels (high school and college)

	Collegiate/		High School		All	
	N	%	N	%	N	%
1982-1983	5	12.5%	35	87.5%	40	100.0%
1983-1984	8	19.0%	34	81.0%	42	100.0%
1984-1985	9	22.5%	31	77.5%	40	100.0%
1985-1986	15	30.6%	34	69.4%	49	100.0%
1986-1987	14	26.9%	38	73.1%	52	100.0%
1987-1988	8	12.3%	57	87.7%	65	100.0%
1988-1989	13	23.2%	43	76.8%	56	100.0%
1989-1990	7	13.5%	45	86.5%	52	100.0%
1990-1991	11	28.2%	28	71.8%	39	100.0%
1991-1992	6	17.6%	28	82.4%	34	100.0%
1992-1993	7	17.9%	32	82.1%	39	100.0%
1993-1994	6	14.0%	37	86.0%	43	100.0%
1994-1995	9	23.7%	29	76.3%	38	100.0%
1995-1996	6	17.6%	28	82.4%	34	100.0%
1996-1997	7	14.0%	43	86.0%	50	100.0%
1997-1998	6	12.0%	44	88.0%	50	100.0%
1998-1999	10	18.2%	45	81.8%	55	100.0%
1999-2000	9	20.9%	34	79.1%	43	100.0%
2000-2001	12	28.6%	30	71.4%	42	100.0%
2001-2002	5	9.6%	47	90.4%	52	100.0%
2002-2003	10	26.3%	28	73.7%	38	100.0%
2003-2004	12	22.2%	42	77.8%	54	100.0%
2004-2005	6	18.2%	27	81.8%	33	100.0%
2005-2006	7	21.9%	25	78.1%	32	100.0%
2006-2007	7	14.9%	40	85.1%	47	100.0%
2007-2008	9	16.7%	45	83.3%	54	100.0%
2008-2009	9	11.5%	69	88.5%	78	100.0%
2009-2010	16	27.1%	43	72.9%	59	100.0%
2010-2011	10	20.0%	40	80.0%	50	100.0%
2011-2012	9	16.4%	46	83.6%	55	100.0%
2012-2013	7	35.0%	13	65.0%	20	100.0%
2013-2014	3	8.6%	32	91.4%	35	100.0%
2014-2015	6	20.0%	24	80.0%	30	100.0%
2015-2016	15	23.8%	48	76.2%	63	100.0%
2016-2017	7	23.3%	23	76.7%	30	100.0%
2017-2018	8	20.5%	31	79.5%	39	100.0%
2018-2019	5	13.5%	32	86.5%	37	100.0%
Total	319	19.1%	1350	80.9%	1669	100.0%
Total*	354	19.9%	1424	80.1%	1778	100.0%

*Includes Cheerleading, Drill Team, Rodeo

Table 3: Number of Exertional/medical (indirect) catastrophic conditions by year: All sports combined, all levels (high school and college)

	Collegiate/		High School		All	
	N	%	N	%	N	%
1982-1983	6	28.6%	15	71.4%	21	100.0%
1983-1984	5	25.0%	15	75.0%	20	100.0%
1984-1985	0	0.0%	11	100.0%	11	100.0%
1985-1986	1	11.1%	8	88.9%	9	100.0%
1986-1987	4	22.2%	14	77.8%	18	100.0%
1987-1988	7	36.8%	12	63.2%	19	100.0%
1988-1989	4	22.2%	14	77.8%	18	100.0%
1989-1990	4	16.7%	20	83.3%	24	100.0%
1990-1991	4	17.4%	19	82.6%	23	100.0%
1991-1992	5	38.5%	8	61.5%	13	100.0%
1992-1993	2	9.5%	19	90.5%	21	100.0%
1993-1994	5	22.7%	17	77.3%	22	100.0%
1994-1995	3	23.1%	10	76.9%	13	100.0%
1995-1996	2	11.1%	16	88.9%	18	100.0%
1996-1997	2	12.5%	14	87.5%	16	100.0%
1997-1998	9	36.0%	16	64.0%	25	100.0%
1998-1999	0	0.0%	23	100.0%	23	100.0%
1999-2000	0	0.0%	27	100.0%	27	100.0%
2000-2001	5	18.5%	22	81.5%	27	100.0%
2001-2002	9	31.0%	20	69.0%	29	100.0%
2002-2003	6	25.0%	18	75.0%	24	100.0%
2003-2004	6	30.0%	14	70.0%	20	100.0%
2004-2005	4	11.4%	31	88.6%	35	100.0%
2005-2006	5	21.7%	18	78.3%	23	100.0%
2006-2007	6	21.4%	22	78.6%	28	100.0%
2007-2008	6	21.4%	22	78.6%	28	100.0%
2008-2009	8	26.7%	22	73.3%	30	100.0%
2009-2010	11	28.2%	28	71.8%	39	100.0%
2010-2011	6	22.2%	21	77.8%	27	100.0%
2011-2012	8	30.8%	18	69.2%	26	100.0%
2012-2013	8	28.6%	20	71.4%	28	100.0%
2013-2014	15	31.9%	32	68.1%	47	100.0%
2014-2015	10	18.9%	43	81.1%	53	100.0%
2015-2016	5	11.6%	38	88.4%	43	100.0%
2016-2017	17	34.0%	33	66.0%	50	100.0%
2017-2018	12	26.7%	33	73.3%	45	100.0%
2018-2019	13	30.2%	30	69.8%	43	100.0%
Total	223	22.6%	763	77.4%	986	100.0%
Total*	223	22.3%	775	77.7%	998	100.0%

*Includes Cheerleading, Drill Team, Rodeo

Table 4a: Number of Traumatic (direct) catastrophic injuries by severity by sport: High school all years combined

		Serious		Non-fatal		Fatal		Unknown		All	
		N	%	N	%	N	%	N	%	N	%
Baseball	Male	29	43.3%	21	31.3%	15	22.4%	2	3.0%	67	100.0%
Basketball	Female	3	50.0%	3	50.0%	0	0.0%	0	0.0%	6	100.0%
	Male	10	62.5%	4	25.0%	1	6.3%	1	6.3%	16	100.0%
Cheerleading	Female	42	58.3%	23	31.9%	1	1.4%	6	8.3%	72	100.0%
	Male	1	50.0%	1	50.0%	0	0.0%	0	0.0%	2	100.0%
Cross Country	Female	0	0.0%	0	0.0%	2	100.0%	0	0.0%	2	100.0%
	Male	0	0.0%	2	66.7%	1	33.3%	0	0.0%	3	100.0%
Field Hockey	Female	0	0.0%	1	33.3%	0	0.0%	2	66.7%	3	100.0%
Football	Male	418	41.9%	417	41.8%	140	14.0%	22	2.2%	997	100.0%
Golf	Male	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1	100.0%
Gymnastics	Female	4	36.4%	7	63.6%	0	0.0%	0	0.0%	11	100.0%
	Male	1	25.0%	2	50.0%	1	25.0%	0	0.0%	4	100.0%
Ice Hockey	Female	2	66.7%	1	33.3%	0	0.0%	0	0.0%	3	100.0%
	Male	11	37.9%	14	48.3%	4	13.8%	0	0.0%	29	100.0%
Lacrosse	Female	2	66.7%	0	0.0%	0	0.0%	1	33.3%	3	100.0%
	Male	10	50.0%	7	35.0%	2	10.0%	1	5.0%	20	100.0%
Skiing	Female	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Soccer	Female	6	66.7%	1	11.1%	2	22.2%	0	0.0%	9	100.0%
	Male	7	41.2%	2	11.8%	7	41.2%	1	5.9%	17	100.0%
Softball	Female	6	85.7%	1	14.3%	0	0.0%	0	0.0%	7	100.0%
Swimming	Female	1	16.7%	5	83.3%	0	0.0%	0	0.0%	6	100.0%
	Male	3	30.0%	6	60.0%	1	10.0%	0	0.0%	10	100.0%
Track and Field	Female	7	70.0%	2	20.0%	1	10.0%	0	0.0%	10	100.0%
	Male	16	28.1%	17	29.8%	21	36.8%	3	5.3%	57	100.0%
Volleyball	Male	0	0.0%	1	100.0%	0	0.0%	0	0.0%	1	100.0%
Wrestling	Male	24	35.8%	39	58.2%	3	4.5%	1	1.5%	67	100.0%

Table 4b: Number of Exertional/medical (indirect) catastrophic conditions by severity by sport: High school all years combined

		Serious		Non-fatal		Fatal		Unknown		All	
		N	%	N	%	N	%	N	%	N	%
Baseball	Male	6	23.1%	0	0.0%	20	76.9%	0	0.0%	26	100.0%
Basketball	Female	2	10.5%	0	0.0%	17	89.5%	0	0.0%	19	100.0%
	Male	31	18.2%	0	0.0%	138	81.2%	1	0.6%	170	100.0%
Cheerleading	Female	4	33.3%	0	0.0%	8	66.7%	0	0.0%	12	100.0%
Cross Country	Female	4	26.7%	0	0.0%	11	73.3%	0	0.0%	15	100.0%
	Male	5	19.2%	0	0.0%	21	80.8%	0	0.0%	26	100.0%
	Unknown	0	0.0%	0	0.0%	0	0.0%	1	100.0%	1	100.0%
Dance	Female	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Field Hockey	Female	0	0.0%	0	0.0%	2	100.0%	0	0.0%	2	100.0%
Football	Male	49	16.4%	2	0.7%	245	82.2%	2	0.7%	298	100.0%
Ice Hockey	Male	3	37.5%	0	0.0%	5	62.5%	0	0.0%	8	100.0%
Lacrosse	Female	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
	Male	1	9.1%	0	0.0%	10	90.9%	0	0.0%	11	100.0%
Other	Female	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Rowing	Male	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1	100.0%
Running/Jogging	Female	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
	Male	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1	100.0%
Soccer	Female	3	21.4%	0	0.0%	11	78.6%	0	0.0%	14	100.0%
	Male	8	19.5%	1	2.4%	30	73.2%	2	4.9%	41	100.0%
Softball	Female	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Swimming	Female	2	18.2%	0	0.0%	8	72.7%	1	9.1%	11	100.0%
	Male	1	12.5%	0	0.0%	7	87.5%	0	0.0%	8	100.0%
Tennis	Female	0	0.0%	0	0.0%	2	100.0%	0	0.0%	2	100.0%
	Male	0	0.0%	0	0.0%	4	100.0%	0	0.0%	4	100.0%
Track and Field	Female	0	0.0%	1	12.5%	7	87.5%	0	0.0%	8	100.0%
	Male	9	18.8%	0	0.0%	38	79.2%	1	2.1%	48	100.0%
Volleyball	Female	2	66.7%	0	0.0%	1	33.3%	0	0.0%	3	100.0%
Water Polo	Female	1	50.0%	0	0.0%	1	50.0%	0	0.0%	2	100.0%
	Male	0	0.0%	0	0.0%	3	100.0%	0	0.0%	3	100.0%
Wrestling	Male	5	13.9%	0	0.0%	30	83.3%	1	2.8%	36	100.0%

Table 5a: Number of Traumatic (direct) catastrophic injuries by severity by sport: College all years combined

		Serious		Non-fatal		Fatal		Unknown		All	
		N	%	N	%	N	%	N	%	N	%
Baseball	Male	9	45.0%	7	35.0%	3	15.0%	1	5.0%	20	100.0%
Basketball	Male	9	81.8%	1	9.1%	1	9.1%	0	0.0%	11	100.0%
Cheerleading	Female	13	46.4%	13	46.4%	1	3.6%	1	3.6%	28	100.0%
	Male	3	60.0%	2	40.0%	0	0.0%	0	0.0%	5	100.0%
Equestrian	Female	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Field Hockey	Female	2	66.7%	0	0.0%	0	0.0%	1	33.3%	3	100.0%
Football	Male	147	68.4%	51	23.7%	17	7.9%	0	0.0%	215	100.0%
Gymnastics	Female	0	0.0%	2	100.0%	0	0.0%	0	0.0%	2	100.0%
	Male	2	66.7%	1	33.3%	0	0.0%	0	0.0%	3	100.0%
	Unknown	0	0.0%	1	100.0%	0	0.0%	0	0.0%	1	100.0%
Ice Hockey	Female	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1	100.0%
	Male	7	58.3%	5	41.7%	0	0.0%	0	0.0%	12	100.0%
Lacrosse	Female	0	0.0%	2	100.0%	0	0.0%	0	0.0%	2	100.0%
	Male	1	16.7%	1	16.7%	4	66.7%	0	0.0%	6	100.0%
Rodeo	Male	0	0.0%	0	0.0%	2	100.0%	0	0.0%	2	100.0%
Rowing	Male	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Rugby	Male	1	25.0%	3	75.0%	0	0.0%	0	0.0%	4	100.0%
Skiing	Female	0	0.0%	1	50.0%	1	50.0%	0	0.0%	2	100.0%
	Male	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Soccer	Female	2	40.0%	2	40.0%	0	0.0%	1	20.0%	5	100.0%
	Male	2	66.7%	1	33.3%	0	0.0%	0	0.0%	3	100.0%
Softball	Female	3	75.0%	0	0.0%	0	0.0%	1	25.0%	4	100.0%
Swimming	Male	0	0.0%	1	100.0%	0	0.0%	0	0.0%	1	100.0%
Track and Field	Female	1	50.0%	1	50.0%	0	0.0%	0	0.0%	2	100.0%
	Male	4	25.0%	6	37.5%	6	37.5%	0	0.0%	16	100.0%
Wrestling	Male	1	33.3%	2	66.7%	0	0.0%	0	0.0%	3	100.0%

Table 5b: Number of Exertional/medical (indirect) catastrophic conditions by severity by sport: College all years combined

		Serious		Fatal		Unknown		All	
		N	%	N	%	N	%	N	%
Baseball	Male	2	22.2%	6	66.7%	1	11.1%	9	100.0%
Basketball	Female	3	37.5%	5	62.5%	0	0.0%	8	100.0%
	Male	17	29.8%	40	70.2%	0	0.0%	57	100.0%
Cross Country	Female	0	0.0%	1	100.0%	0	0.0%	1	100.0%
	Male	2	50.0%	2	50.0%	0	0.0%	4	100.0%
Football	Male	17	19.5%	69	79.3%	1	1.1%	87	100.0%
Gymnastics	Female	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Ice Hockey	Male	3	75.0%	1	25.0%	0	0.0%	4	100.0%
Lacrosse	Male	0	0.0%	2	100.0%	0	0.0%	2	100.0%
Other	Male	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Rowing	Male	0	0.0%	2	100.0%	0	0.0%	2	100.0%
Skiing	Male	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Soccer	Female	1	25.0%	3	75.0%	0	0.0%	4	100.0%
	Male	2	25.0%	6	75.0%	0	0.0%	8	100.0%
Swimming	Female	1	25.0%	3	75.0%	0	0.0%	4	100.0%
	Male	0	0.0%	8	100.0%	0	0.0%	8	100.0%
Tennis	Female	0	0.0%	1	100.0%	0	0.0%	1	100.0%
	Male	0	0.0%	1	100.0%	0	0.0%	1	100.0%
Track and Field	Male	3	60.0%	2	40.0%	0	0.0%	5	100.0%
Volleyball	Female	2	50.0%	2	50.0%	0	0.0%	4	100.0%
Water Polo	Male	0	0.0%	2	100.0%	0	0.0%	2	100.0%
Wrestling	Male	3	33.3%	6	66.7%	0	0.0%	9	100.0%

Table 6a: Number of catastrophic traumatic injuries (direct) and exertional/medical conditions (indirect) by Severity by year: High school

	Fatal		Non-fatal		Serious	
	N	Rate per 100,000	N	Rate per 100,000	N	Rate per 100,000
1982-1983	25	0.49	10	0.20	15	0.30
1983-1984	23	0.46	15	0.30	11	0.22
1984-1985	17	0.34	13	0.26	12	0.24
1985-1986	10	0.20	15	0.29	16	0.31
1986-1987	26	0.51	12	0.23	12	0.23
1987-1988	17	0.33	25	0.48	27	0.52
1988-1989	21	0.40	19	0.37	17	0.33
1989-1990	24	0.46	26	0.50	15	0.29
1990-1991	23	0.44	15	0.29	9	0.17
1991-1992	12	0.23	9	0.17	15	0.28
1992-1993	23	0.43	14	0.26	14	0.26
1993-1994	22	0.40	14	0.25	16	0.29
1994-1995	12	0.21	14	0.25	13	0.23
1995-1996	19	0.32	13	0.22	9	0.15
1996-1997	24	0.40	16	0.26	14	0.23
1997-1998	24	0.38	23	0.37	12	0.19
1998-1999	31	0.48	13	0.20	23	0.36
1999-2000	33	0.51	16	0.25	11	0.17
2000-2001	26	0.39	15	0.23	11	0.17
2001-2002	28	0.43	19	0.29	17	0.26
2002-2003	21	0.31	11	0.16	13	0.19
2003-2004	17	0.25	23	0.34	15	0.22
2004-2005	34	0.50	15	0.22	7	0.10
2005-2006	20	0.29	12	0.17	11	0.16
2006-2007	21	0.29	23	0.32	18	0.25
2007-2008	23	0.32	15	0.21	29	0.40
2008-2009	28	0.38	30	0.41	33	0.45
2009-2010	24	0.32	21	0.28	26	0.35
2010-2011	24	0.32	16	0.22	21	0.28
2011-2012	22	0.30	24	0.32	18	0.24
2012-2013	21	0.28	6	0.08	6	0.08
2013-2014	24	0.33	9	0.12	26	0.36
2014-2015	24	0.32	7	0.09	34	0.45
2015-2016	28	0.37	10	0.13	44	0.58
2016-2017	16	0.21	5	0.07	32	0.42
2017-2018	15	0.20	8	0.10	37	0.48
2018-2019	16	0.21	6	0.08	36	0.47

Note: Rates with number of incidents less than 5 should be interpreted with caution.

Table 6b: Number of catastrophic traumatic injuries (direct) and exertional/medical conditions (indirect) by Severity by year: College

	Fatal		Non-fatal		Serious	
	N	Rate per 100,000	N	Rate per 100,000	N	Rate per 100,000
1982-1983	7	2.73	3	1.17	1	0.39
1983-1984	5	1.85	2	0.74	6	2.22
1984-1985	1	0.35	3	1.04	5	1.73
1985-1986	4	1.38	4	1.38	8	2.75
1986-1987	5	1.80	2	0.72	11	3.96
1987-1988	7	2.64	1	0.38	7	2.64
1988-1989	4	1.49	4	1.49	9	3.34
1989-1990	4	1.51	2	0.76	4	1.51
1990-1991	5	1.82	6	2.18	4	1.45
1991-1992	5	1.78	1	0.36	5	1.78
1992-1993	3	1.05	--	--	6	2.11
1993-1994	7	2.39	--	--	4	1.37
1994-1995	3	1.01	3	1.01	6	2.02
1995-1996	2	0.60	4	1.19	2	0.60
1996-1997	3	0.91	5	1.51	1	0.30
1997-1998	9	2.68	1	0.30	5	1.49
1998-1999	2	0.56	3	0.84	5	1.40
1999-2000	2	0.56	2	0.56	5	1.40
2000-2001	7	1.89	4	1.08	6	1.62
2001-2002	10	2.74	1	0.27	3	0.82
2002-2003	6	1.60	3	0.80	7	1.87
2003-2004	9	2.39	4	1.06	5	1.33
2004-2005	4	1.04	2	0.52	4	1.04
2005-2006	5	1.27	4	1.01	2	0.51
2006-2007	6	1.48	1	0.25	6	1.48
2007-2008	5	1.21	1	0.24	9	2.17
2008-2009	5	1.18	1	0.24	11	2.60
2009-2010	13	3.01	2	0.46	12	2.78
2010-2011	4	0.90	8	1.80	3	0.67
2011-2012	9	1.98	0	0.00	8	1.76
2012-2013	7	1.51	3	0.65	4	0.86
2013-2014	6	1.26	--	--	12	2.53
2014-2015	4	0.83	1	0.21	11	2.27
2015-2016	3	0.62	3	0.62	13	2.67
2016-2017	5	1.02	2	0.41	17	3.45
2017-2018	5	1.01	1	0.20	14	2.83
2018-2019	9	1.80	1	0.20	7	1.40

Note: Rates with number of incidents less than 5 should be interpreted with caution.

Table 7a: Rate of traumatic (direct) catastrophic injuries by severity by year: High school

	Fatal		Non-fatal		Serious	
	N	Rate per 100,000	N	Rate per 100,000	N	Rate per 100,000
1982-1983	10	0.20	10	0.20	15	0.30
1983-1984	8	0.16	15	0.30	11	0.22
1984-1985	6	0.12	13	0.26	12	0.24
1985-1986	3	0.06	15	0.29	16	0.31
1986-1987	13	0.25	12	0.23	11	0.21
1987-1988	5	0.10	25	0.48	27	0.52
1988-1989	8	0.15	19	0.37	16	0.31
1989-1990	5	0.10	26	0.50	14	0.27
1990-1991	4	0.08	15	0.29	9	0.17
1991-1992	4	0.08	9	0.17	15	0.28
1992-1993	4	0.08	14	0.26	14	0.26
1993-1994	5	0.09	14	0.25	16	0.29
1994-1995	2	0.04	14	0.25	13	0.23
1995-1996	4	0.07	13	0.22	9	0.15
1996-1997	10	0.16	16	0.26	14	0.23
1997-1998	8	0.13	23	0.37	12	0.19
1998-1999	8	0.13	13	0.20	23	0.36
1999-2000	7	0.11	16	0.25	10	0.16
2000-2001	4	0.06	15	0.23	11	0.17
2001-2002	9	0.14	19	0.29	17	0.26
2002-2003	3	0.04	11	0.16	13	0.19
2003-2004	3	0.04	23	0.34	15	0.22
2004-2005	5	0.07	15	0.22	6	0.09
2005-2006	4	0.06	12	0.17	9	0.13
2006-2007	2	0.03	22	0.31	16	0.22
2007-2008	2	0.03	15	0.21	28	0.39
2008-2009	10	0.14	30	0.41	29	0.40
2009-2010	2	0.03	20	0.27	21	0.28
2010-2011	6	0.08	16	0.22	18	0.24
2011-2012	4	0.05	24	0.32	18	0.24
2012-2013	4	0.05	5	0.07	4	0.05
2013-2014	8	0.11	9	0.12	13	0.18
2014-2015	6	0.08	6	0.08	10	0.13
2015-2016	8	0.11	10	0.13	27	0.36
2016-2017	2	0.03	5	0.07	14	0.18
2017-2018	3	0.04	8	0.10	16	0.21
2018-2019	3	0.04	6	0.08	19	0.25

Note: Rates with number of incidents less than 5 should be interpreted with caution.

Table 7b: Rate of traumatic (direct) catastrophic injuries by severity by year: College

	Fatal		Non-fatal		Serious	
	N	Rate per 100,000	N	Rate per 100,000	N	Rate per 100,000
1982-1983	1	0.39	3	1.17	1	0.39
1983-1984	--	--	2	0.74	6	2.22
1984-1985	1	0.35	3	1.04	5	1.73
1985-1986	3	1.03	4	1.38	8	2.75
1986-1987	1	0.36	2	0.72	11	3.96
1987-1988	--	--	1	0.38	7	2.64
1988-1989	--	--	4	1.49	9	3.34
1989-1990	1	0.38	2	0.76	4	1.51
1990-1991	1	0.36	6	2.18	4	1.45
1991-1992	1	0.36	1	0.36	4	1.43
1992-1993	1	0.35	--	--	6	2.11
1993-1994	2	0.68	--	--	4	1.37
1994-1995	--	--	3	1.01	6	2.02
1995-1996	--	--	4	1.19	2	0.60
1996-1997	1	0.30	5	1.51	1	0.30
1997-1998	1	0.30	1	0.30	4	1.19
1998-1999	2	0.56	3	0.84	5	1.40
1999-2000	2	0.56	2	0.56	5	1.40
2000-2001	2	0.54	4	1.08	6	1.62
2001-2002	1	0.27	1	0.27	3	0.82
2002-2003	1	0.27	3	0.80	6	1.60
2003-2004	3	0.80	4	1.06	5	1.33
2004-2005	1	0.26	2	0.52	3	0.78
2005-2006	--	--	4	1.01	2	0.51
2006-2007	--	--	1	0.25	6	1.48
2007-2008	--	--	1	0.24	8	1.93
2008-2009	--	--	1	0.24	8	1.89
2009-2010	4	0.93	2	0.46	10	2.32
2010-2011	--	--	8	1.80	2	0.45
2011-2012	2	0.44	--	--	7	1.54
2012-2013	--	--	3	0.65	3	0.65
2013-2014	1	0.21	--	--	2	0.42
2014-2015	--	--	1	0.21	5	1.03
2015-2016	--	--	3	0.62	11	2.26
2016-2017	--	--	2	0.41	5	1.02
2017-2018	2	0.40	1	0.20	5	1.01
2018-2019	--	--	1	0.20	3	0.60

Note: Rates with number of incidents less than 5 should be interpreted with caution.

Table 8a: Rate of exertional/medical (indirect) catastrophic conditions by severity by year: High School

	Fatal		Non-fatal		Serious	
	N	Rate per 100,000	N	Rate per 100,000	N	Rate per 100,000
1982-1983	15	0.30	--	--	--	--
1983-1984	15	0.30	--	--	--	--
1984-1985	11	0.22	--	--	--	--
1985-1986	7	0.14	--	--	--	--
1986-1987	13	0.25	--	--	1	0.02
1987-1988	12	0.23	--	--	--	--
1988-1989	13	0.25	--	--	1	0.02
1989-1990	19	0.37	--	--	1	0.02
1990-1991	19	0.36	--	--	--	--
1991-1992	8	0.15	--	--	--	--
1992-1993	19	0.36	--	--	--	--
1993-1994	17	0.31	--	--	--	--
1994-1995	10	0.18	--	--	--	--
1995-1996	15	0.25	--	--	--	--
1996-1997	14	0.23	--	--	--	--
1997-1998	16	0.26	--	--	--	--
1998-1999	23	0.36	--	--	--	--
1999-2000	26	0.40	--	--	1	0.02
2000-2001	22	0.33	--	--	--	--
2001-2002	19	0.29	--	--	--	--
2002-2003	18	0.27	--	--	--	--
2003-2004	14	0.21	--	--	--	--
2004-2005	29	0.42	--	--	1	0.01
2005-2006	16	0.23	--	--	2	0.03
2006-2007	19	0.27	1	0.01	2	0.03
2007-2008	21	0.29	--	--	1	0.01
2008-2009	18	0.25	--	--	4	0.05
2009-2010	22	0.30	1	0.01	5	0.07
2010-2011	18	0.24	--	--	3	0.04
2011-2012	18	0.24	--	--	--	--
2012-2013	17	0.23	1	0.01	2	0.03
2013-2014	16	0.22	--	--	13	0.18
2014-2015	18	0.24	1	0.01	24	0.32
2015-2016	20	0.26	--	--	17	0.22
2016-2017	14	0.18	--	--	18	0.23
2017-2018	12	0.16	--	--	21	0.27
2018-2019	13	0.17	--	--	17	0.22

Note: Rates with number of incidents less than 5 should be interpreted with caution.

Table 8b: Rate of exertional/medical (indirect) catastrophic conditions by severity by year: College

	Fatal		Serious	
	N	Rate per 100,000	N	Rate per 100,000
1982-1983	6	2.34	--	--
1983-1984	5	1.85	--	--
1985-1986	1	0.34	--	--
1986-1987	4	1.44	--	--
1987-1988	7	2.64	--	--
1988-1989	4	1.49	--	--
1989-1990	3	1.14	--	--
1990-1991	4	1.45	--	--
1991-1992	4	1.43	1	0.36
1992-1993	2	0.70	--	--
1993-1994	5	1.71	--	--
1994-1995	3	1.01	--	--
1995-1996	2	0.60	--	--
1996-1997	2	0.60	--	--
1997-1998	8	2.38	1	0.30
2000-2001	5	1.35	--	--
2001-2002	9	2.47	--	--
2002-2003	5	1.34	1	0.27
2003-2004	6	1.59	--	--
2004-2005	3	0.78	1	0.26
2005-2006	5	1.27	--	--
2006-2007	6	1.48	--	--
2007-2008	5	1.21	1	0.24
2008-2009	5	1.18	3	0.71
2009-2010	9	2.08	2	0.46
2010-2011	4	0.90	1	0.22
2011-2012	7	1.54	1	0.22
2012-2013	7	1.51	1	0.22
2013-2014	5	1.05	10	2.11
2014-2015	4	0.83	6	1.24
2015-2016	3	0.62	2	0.41
2016-2017	5	1.02	12	2.44
2017-2018	3	0.61	9	1.82
2018-2019	9	1.80	4	0.80

Note: Rates with number of incidents less than 5 should be interpreted with caution.

**Table 9a: Rate of Traumatic (direct) catastrophic injuries by level and severity by sport:
High school**

		Fatal		Non-fatal		Serious	
		N	Rate per 100,000	N	Rate per 100,000	N	Rate per 100,000
Baseball	Male	15	0.09	21	0.13	29	0.17
Basketball	Female	--	--	3	0.02	3	0.02
	Male	1	0.01	4	0.02	10	0.05
Cheerleading	Female	1	0.04	23	0.92	42	1.68
	Male	--	--	1	1.60	1	1.60
Cross Country	Female	2	0.03	--	--	--	--
	Male	1	0.01	2	0.03	--	--
Field Hockey	Female	--	--	1	0.05	--	--
Football	Male	140	0.38	417	1.12	418	1.12
Golf	Male	--	--	--	--	1	0.02
Gymnastics	Female	--	--	7	0.83	4	0.47
	Male	1	0.83	2	1.66	1	0.83
Ice Hockey	Female	--	--	1	0.58	2	1.15
	Male	4	0.36	14	1.25	11	0.99
Lacrosse	Female	--	--	--	--	2	0.13
	Male	2	0.10	7	0.35	10	0.50
Skiing	Female	1	0.33	--	--	--	--
Soccer	Female	2	0.02	1	0.01	6	0.06
	Male	7	0.06	2	0.02	7	0.06
Softball	Female	--	--	1	0.01	6	0.05
Swimming	Female	--	--	5	0.11	1	0.02
	Male	1	0.03	6	0.16	3	0.08
Track and Field	Female	1	0.01	2	0.01	7	0.04
	Male	21	0.10	17	0.08	16	0.08
Volleyball	Male	--	--	1	0.08	--	--
Wrestling	Male	3	0.03	39	0.43	24	0.26

Note: Rates with number of incidents less than 5 should be interpreted with caution.

**Table 9b: Rate of Traumatic (direct) catastrophic injuries by level and severity by sport:
College**

		Fatal		Non-fatal		Serious	
		N	Rate per 100,000	N	Rate per 100,000	N	Rate per 100,000
Baseball	Male	3	0.30	7	0.71	9	0.91
Basketball	Male	1	0.17	1	0.17	9	1.56
Cheerleading*	Female	1	NA	13	NA	13	NA
	Male	--	--	2	NA	3	NA
Equestrian	Female	1	3.68	--	--	--	--
Field Hockey	Female	--	--	--	--	2	0.99
Football	Male	17	0.78	51	2.34	147	6.75
Gymnastics	Female	--	--	2	3.61	--	--
	Male	--	--	1	5.27	2	10.55
Ice Hockey	Female	--	--	--	--	1	2.38
	Male	--	--	5	3.45	7	4.83
Lacrosse	Female	--	--	2	0.92	--	--
	Male	4	1.39	1	0.35	1	0.35
Rowing	Male	1	1.25	--	--	--	--
Skiing	Female	1	5.48	1	5.48	--	--
	Male	1	4.53	--	--	--	--
Soccer	Female	--	--	2	0.33	2	0.33
	Male	--	--	1	0.14	2	0.29
Softball	Female	--	--	--	--	3	0.56
Swimming	Male	--	--	1	0.33	--	--
Track and Field	Female	--	--	1	0.08	1	0.08
	Male	6	0.40	6	0.40	4	0.27
Wrestling	Male	--	--	2	0.79	1	0.40

Note: Rates with number of incidents less than 5 should be interpreted with caution.

*Unable to compute, Number of collegiate cheerleaders unknown

**Table 10a: Exertional/medical (indirect) catastrophic conditions by level and severity:
High school**

		Fatal		Non-fatal		Serious	
		N	Rate per 100,000	N	Rate per 100,000	N	Rate per 100,000
Baseball	Male	20	0.12	--	--	6	0.04
Basketball	Female	17	0.11	--	--	2	0.01
	Male	138	0.70	--	--	31	0.16
Cheerleading	Female	8	0.32	--	--	4	0.16
Cross Country	Female	11	0.19	--	--	4	0.07
	Male	21	0.30	--	--	5	0.07
Field Hockey	Female	2	0.09	--	--	--	--
Football	Male	245	0.66	2	0.01	49	0.13
Ice Hockey	Male	5	0.45	--	--	3	0.27
Lacrosse	Female	1	0.07	--	--	--	--
	Male	10	0.50	--	--	1	0.05
Rowing	Male	--	--	--	--	1	1.71
Soccer	Female	11	0.12	--	--	3	0.03
	Male	30	0.25	1	0.01	8	0.07
Softball	Female	1	0.01	--	--	--	--
Swimming	Female	8	0.17	--	--	2	0.04
	Male	7	0.18	--	--	1	0.03
Tennis	Female	2	0.03	--	--	--	--
	Male	4	0.07	--	--	--	--
Track and Field	Female	7	0.04	1	0.01	--	--
	Male	38	0.19	--	--	9	0.04
Volleyball	Female	1	0.01	--	--	2	0.01
Water Polo	Female	1	0.25	--	--	1	0.25
	Male	3	0.55	--	--	--	--
Wrestling	Male	30	0.33	--	--	5	0.05

Note: Rates with number of incidents less than 5 should be interpreted with caution.

**Table 10b: Exertional/medical (indirect) catastrophic conditions by level and severity:
College**

		Fatal		Serious	
		N	Rate per 100,000	N	Rate per 100,000
Baseball	Male	6	0.61	2	0.20
Basketball	Female	5	0.98	3	0.59
	Male	40	6.95	17	2.95
Cross Country	Female	1	0.24	--	--
	Male	2	0.47	2	0.47
Football	Male	69	3.17	17	0.78
Gymnastics	Female	1	1.81	--	--
Ice Hockey	Male	1	0.69	3	2.07
Lacrosse	Male	2	0.69	--	--
Rowing	Male	2	2.49	--	--
Skiing	Male	1	4.53	--	--
Soccer	Female	3	0.49	1	0.16
	Male	6	0.87	2	0.29
Swimming	Female	3	0.81	1	0.27
	Male	8	2.61	--	--
Tennis	Female	1	0.33	--	--
	Male	1	0.35	--	--
Track and Field	Male	2	0.13	3	0.20
Volleyball	Female	2	0.42	2	0.42
Water Polo	Male	2	5.46	--	--
Wrestling	Male	6	2.37	3	1.19

Note: Rates with number of incidents less than 5 should be interpreted with caution.

Table 11: Characteristics of all sport-related catastrophic traumatic injuries (direct) and exertional/medical conditions (indirect) during AY 2018-2019

	Traumatic injury (Direct)		Exertional/Medical (Indirect)		All	
	N	%	N	%	N	%
Total	37	100.0%	43	100.0%	80	100.0%
Sport Level						
Collegiate/University	5	13.5%	13	30.2%	18	22.5%
High School Sponsored	32	86.5%	30	69.8%	62	77.5%
Severity						
Serious	22	59.5%	21	48.8%	43	53.8%
Non-fatal	7	18.9%	0	0.0%	7	8.8%
Fatal	3	8.1%	22	51.2%	25	31.3%
Unknown	5	13.5%	0	0.0%	5	6.3%
Sex						
Female	2	5.4%	5	11.6%	7	8.8%
Male	35	94.6%	38	88.4%	73	91.3%
Month						
Jul-Aug	11	29.7%	11	25.6%	22	27.5%
Sep-Oct	16	43.2%	8	18.6%	24	30.0%
Nov-Dec	1	2.7%	6	14.0%	7	8.8%
Jan-Feb	1	2.7%	3	7.0%	4	5.0%
Mar-Apr	5	13.5%	7	16.3%	12	15.0%
May-Jun	3	8.1%	8	18.6%	11	13.8%
Sport						
Baseball	1	2.7%	2	4.7%	3	3.8%
Basketball	1	2.7%	11	25.6%	12	15.0%
Cross Country	0	0.0%	2	4.7%	2	2.5%
Dance	0	0.0%	1	2.3%	1	1.3%
Football	28	75.7%	20	46.5%	48	60.0%
Lacrosse	2	5.4%	0	0.0%	2	2.5%
Other	0	0.0%	1	2.3%	1	1.3%
Running/Jogging	0	0.0%	1	2.3%	1	1.3%
Soccer	2	5.4%	1	2.3%	3	3.8%
Track and Field	3	8.1%	3	7.0%	6	7.5%
Water Polo	0	0.0%	1	2.3%	1	1.3%
Sponsored activity						
Official school or team related ATHLETIC activity	36	97.3%	37	86.0%	73	91.3%
Personal athletic activity	1	2.7%	6	14.0%	7	8.8%
Location						
Athlete's Home	0	0.0%	2	4.7%	2	2.5%
Competitive Venue	33	89.2%	23	53.5%	56	70.0%
Public Park	0	0.0%	3	7.0%	3	3.8%
School Athletic Facility	3	8.1%	14	32.6%	17	21.3%

	Traumatic injury (Direct)		Exertional/Medical (Indirect)		All	
	N	%	N	%	N	%
School Campus (non-athletic facility)	1	2.7%	1	2.3%	2	2.5%
Event Type						
Competition/Game	29	78.4%	10	23.3%	39	48.8%
Conditioning Session	0	0.0%	9	20.9%	9	11.3%
Other	0	0.0%	1	2.3%	1	1.3%
Practice	4	10.8%	17	39.5%	21	26.3%
Scrimmage	3	8.1%	0	0.0%	3	3.8%
Strength/Weight Session	1	2.7%	1	2.3%	2	2.5%
Unaffiliated Recreational Activity	0	0.0%	5	11.6%	5	6.3%
Player action						
5,000 m/3mi	0	0.0%	1	2.3%	1	1.3%
Being blocked	1	2.7%	0	0.0%	1	1.3%
Being tackled	8	21.6%	0	0.0%	8	10.0%
Conditioning (land)	1	2.7%	11	25.6%	12	15.0%
Defending	1	2.7%	0	0.0%	1	1.3%
Does not apply	0	0.0%	3	7.0%	3	3.8%
General play	2	5.4%	14	32.6%	16	20.0%
Heading ball	1	2.7%	0	0.0%	1	1.3%
Jumping - High jump	0	0.0%	1	2.3%	1	1.3%
Other	3	8.1%	2	4.7%	5	6.3%
Pitching	1	2.7%	1	2.3%	2	2.5%
Pole vaulting	1	2.7%	0	0.0%	1	1.3%
Receiving pass	1	2.7%	0	0.0%	1	1.3%
Running (middle/long distance)	0	0.0%	3	7.0%	3	3.8%
Shooting	1	2.7%	1	2.3%	2	2.5%
Tackling	9	24.3%	0	0.0%	9	11.3%
Unknown	7	18.9%	5	11.6%	12	15.0%
Weights	0	0.0%	1	2.3%	1	1.3%
Basic Mechanism						
Contact with Another Player	28	75.7%	0	0.0%	28	35.0%
Contact with Apparatus or Object	3	8.1%	1	2.3%	4	5.0%
Contact with Ground/Surface	3	8.1%	0	0.0%	3	3.8%
Environmental (e.g., lightning strike)	0	0.0%	12	27.9%	12	15.0%
Infection or Illness	0	0.0%	29	67.4%	29	36.3%
Other	1	2.7%	1	2.3%	2	2.5%
Unknown	2	5.4%	0	0.0%	2	2.5%
Major Injury Category						
Head Injury	13	35.1%	0	0.0%	13	16.3%
Heat-related injury	0	0.0%	12	27.9%	12	15.0%

	Traumatic injury (Direct)		Exertional/Medical (Indirect)		All	
	N	%	N	%	N	%
Hit in the Chest	1	2.7%	0	0.0%	1	1.3%
Other	0	0.0%	2	4.7%	2	2.5%
Other Traumatic Injury	5	13.5%	0	0.0%	5	6.3%
Spinal Cord Injury	18	48.6%	0	0.0%	18	22.5%
Sudden Cardiac Arrest	0	0.0%	29	67.4%	29	36.3%
Detailed Injury Category						
Cardiac/Sudden Cardiac Arrest (not Commotio Cordis)	0	0.0%	29	67.4%	29	36.3%
Heat-Related Injury (e.g. Heatstroke)	0	0.0%	11	25.6%	11	13.8%
Hyponatremia	0	0.0%	1	2.3%	1	1.3%
Other Traumatic Injury (e.g. Ruptured Spleen)	8	21.6%	0	0.0%	8	10.0%
Spinal Cord Injury with a Fracture	4	10.8%	0	0.0%	4	5.0%
Spinal Cord Injury without Spine Fracture	6	16.2%	0	0.0%	6	7.5%
Spine Fracture	9	24.3%	1	2.3%	10	12.5%
Traumatic Brain Injury (e.g. subdural hematoma)	10	27.0%	0	0.0%	10	12.5%
Traumatic Pulmonary Injury (e.g. Pneumothorax or Pulmonary Contusion)	0	0.0%	1	2.3%	1	1.3%
Injury Outcome						
Fatality/Sudden Death	3	8.1%	22	51.2%	25	31.3%
Non-trauma Survivor (e.g. sudden cardiac arrest, heat stroke, exertional sickling)	0	0.0%	19	44.2%	19	23.8%
Trauma-related Non-Fatality - Disability unknown/uncertain	5	13.5%	0	0.0%	5	6.3%
Trauma-related Non-Fatality with Permanent Disability	7	18.9%	0	0.0%	7	8.8%
Trauma-related Non-Fatality with Temporary Disability (full recovery expected or confirmed)	22	59.5%	2	4.7%	24	30.0%

Table 12. Participation numbers, 1982/83 to 2018/19

	High School ¹		College ²	
	Female	Male	Female	Male
Baseball	36,057	16,626,924	--	986,081
Basketball	15,771,216	19,776,025	508,390	575,709
Cheerleading³	2,500,001	62,361	--	--
Cross Country	5,852,778	6,928,354	422,401	426,215
Equestrian⁴	24,352	3,998	27,185	1,077
Field Hockey	2,107,645	5,432	201,054	--
Football	36,637	37,164,301	--	2,178,115
Golf	1,991,964	5,307,508	115,525	285,281
Gymnastics	843,662	120,820	55,375	18,958
Ice Hockey	173,342	1,116,246	41,970	144,943
Lacrosse	1,493,364	1,999,899	217,130	288,705
Rowing⁴	66,439	58,556	180,182	80,164
Skiing	306,003	366,023	18,263	22,098
Soccer	9,307,868	11,835,779	614,624	692,758
Softball	12,295,068	57,000	535,320	--
Swimming/Diving	4,745,602	3,790,212	370,582	306,029
Tennis	5,799,055	5,369,484	301,694	287,704
Track and Field⁵	16,733,866	20,519,788	1,317,991	1,506,690
Volleyball⁶	13,544,919	1,305,840	480,764	44,875
Water Polo	404,374	547,539	25,009	36,607
Wrestling	170,089	9,096,747	49	252,878

¹NFHS available online: <https://www.nfhs.org/ParticipationStatistics/ParticipationStatistics/>

²NCAA accessed online: https://ncaaorg.s3.amazonaws.com/research/sportpart/2018-19RES_SportsSponsorshipParticipationRatesReport.pdf

³Cheerleading is not an official sport for NCAA collegiate athletes.

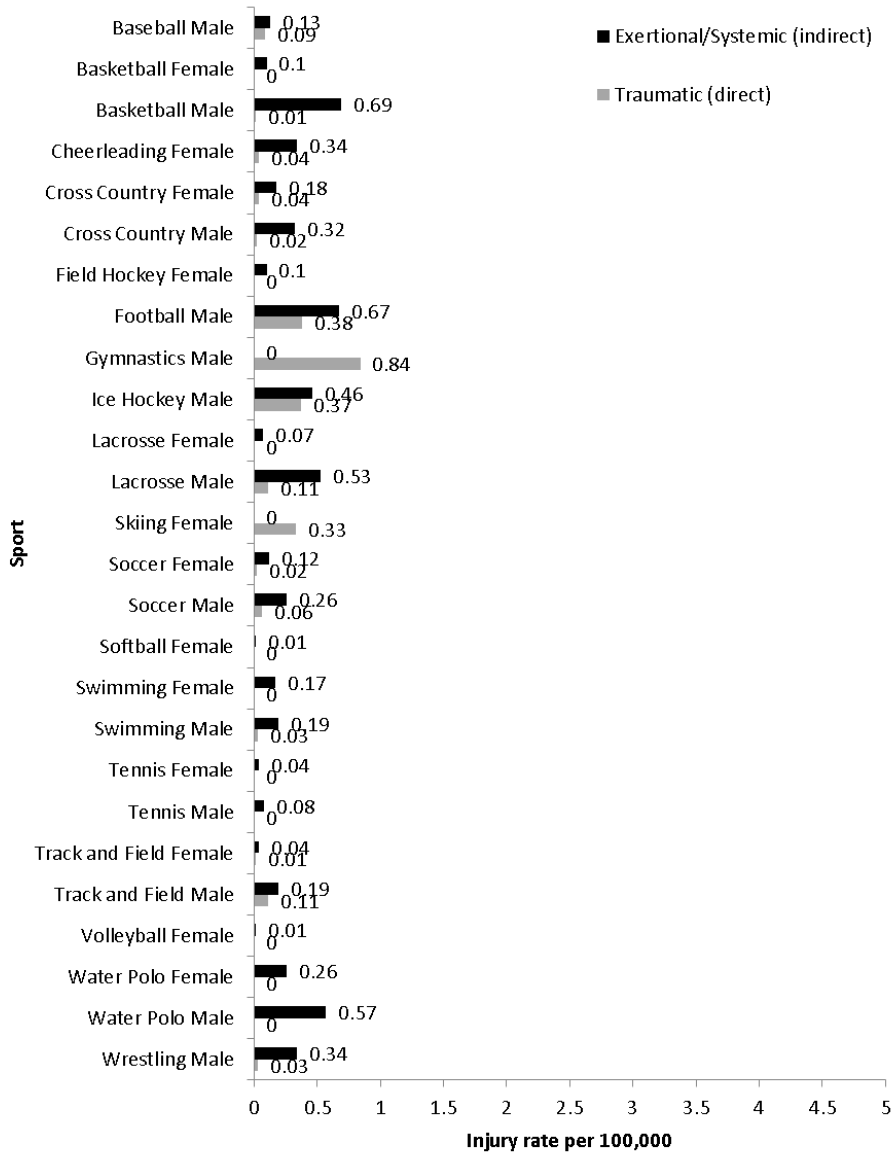
⁴Equestrian (male and female) and rowing (males) are non-championship NCAA collegiate sports.

⁵Includes both indoor and outdoor track and field.

⁶Includes sand volleyball.

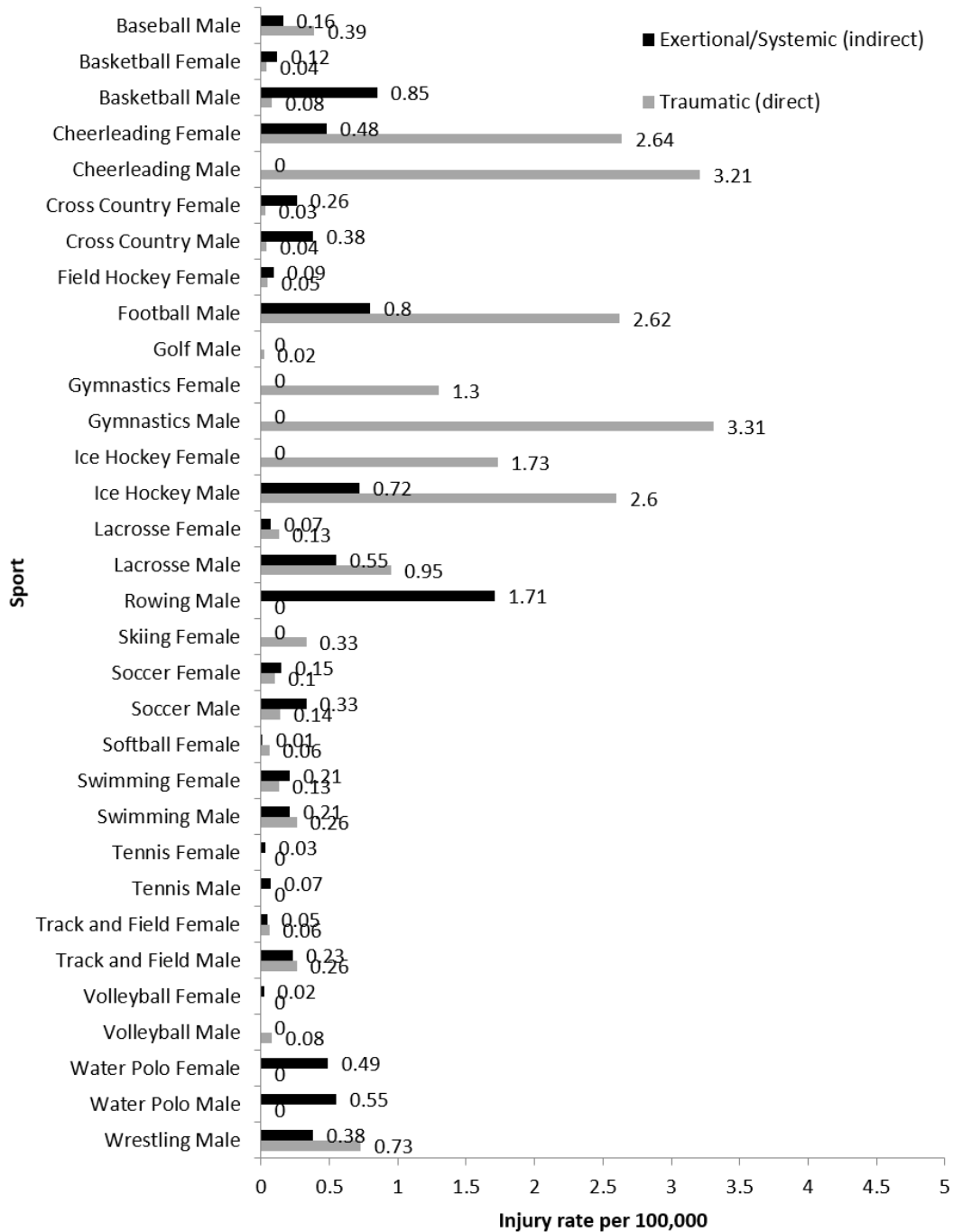
Note: Not all high schools and colleges are members of the NFHS and NCAA. Complete data are not available for the non-member schools. Therefore, these participation numbers underestimate the total number of high school and collegiate participants in the United States.

Figure 1: Rates of fatal catastrophic traumatic injury (direct) and exertional/medical (indirect) conditions by sport-gender among high school participants, 1982/83-2018/19



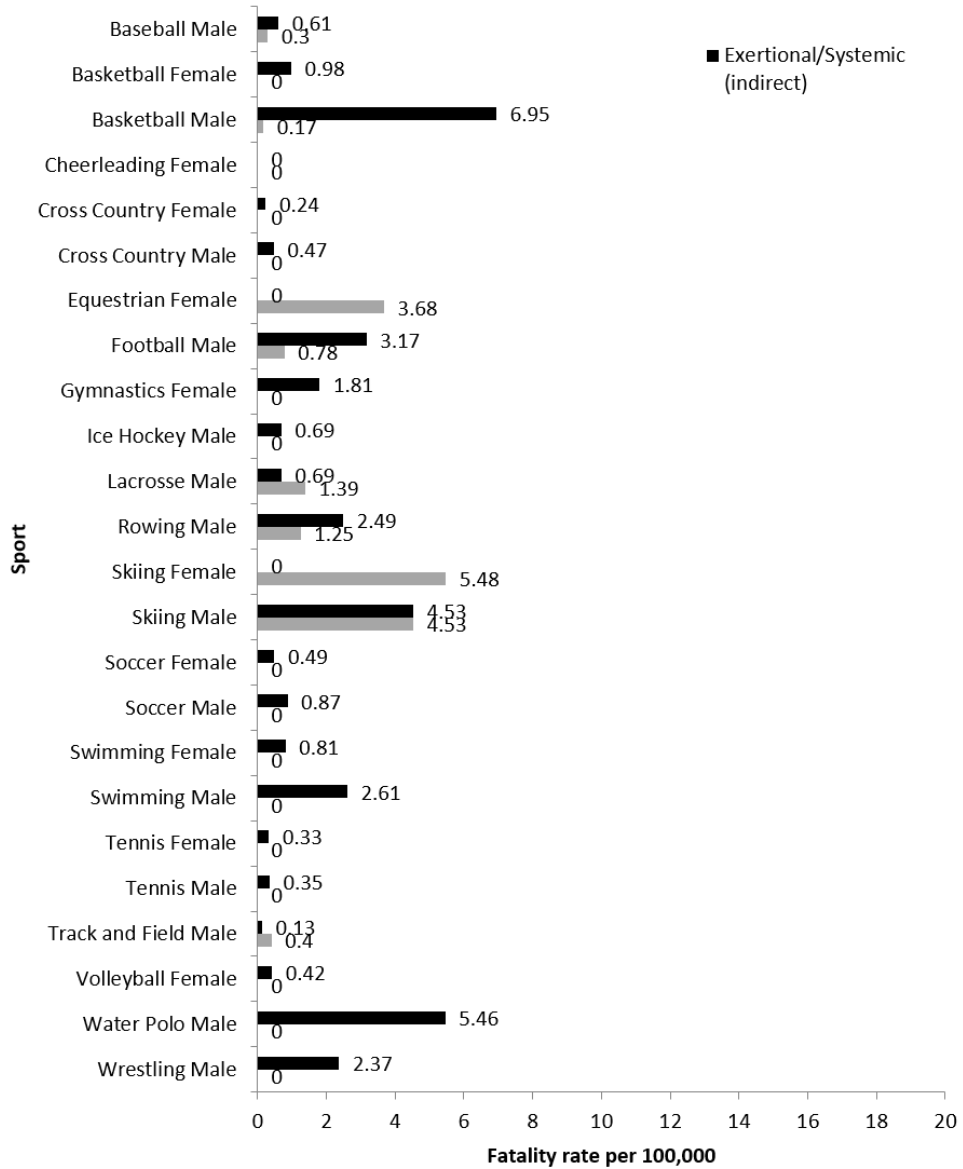
Note: Rates with number of incidents less than 5 should be interpreted with caution.

Figure 2: Rates of all catastrophic traumatic injury (direct) and exertional/medical (indirect) conditions by sport-gender among high school participants, 1982/83-2018/19



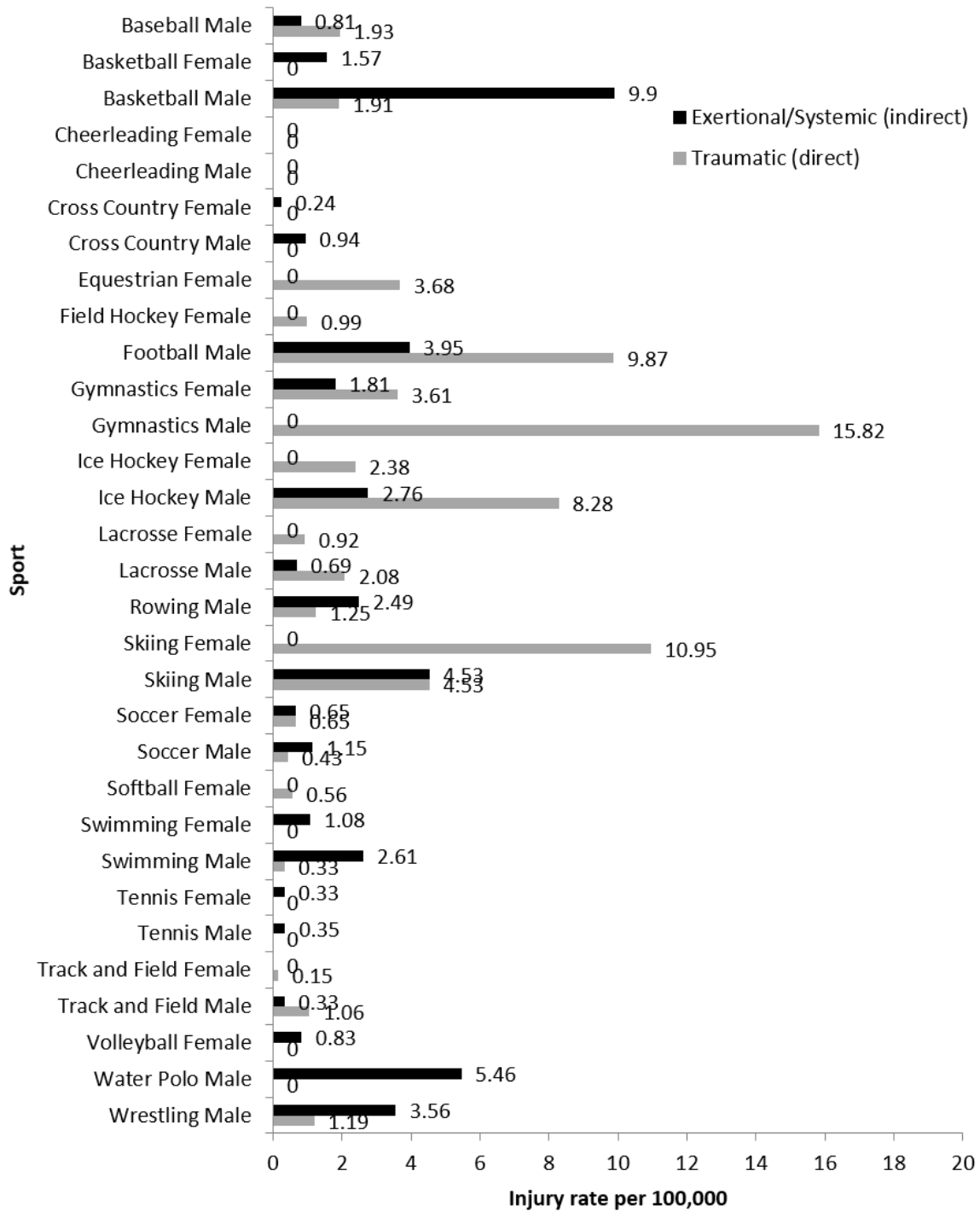
Note: Rates with number of incidents less than 5 should be interpreted with caution.

Figure 3: Rates of fatal catastrophic traumatic injury (direct) and exertional/medical (indirect) conditions by sport-gender among collegiate participants, 1982/83-2018/19



Note: Rates with number of incidents less than 5 should be interpreted with caution.

Figure 4: Rates of all catastrophic traumatic injury (direct) and exertional/medical (indirect) conditions by sport-gender among collegiate participants, 1982/83-2018/19



Note: Rates with number of incidents less than 5 should be interpreted with caution.