

**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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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 an 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

**Case summaries have been redacted from the publicly available report. Please email nccsir@unc.edu to request case summaries.*

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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.

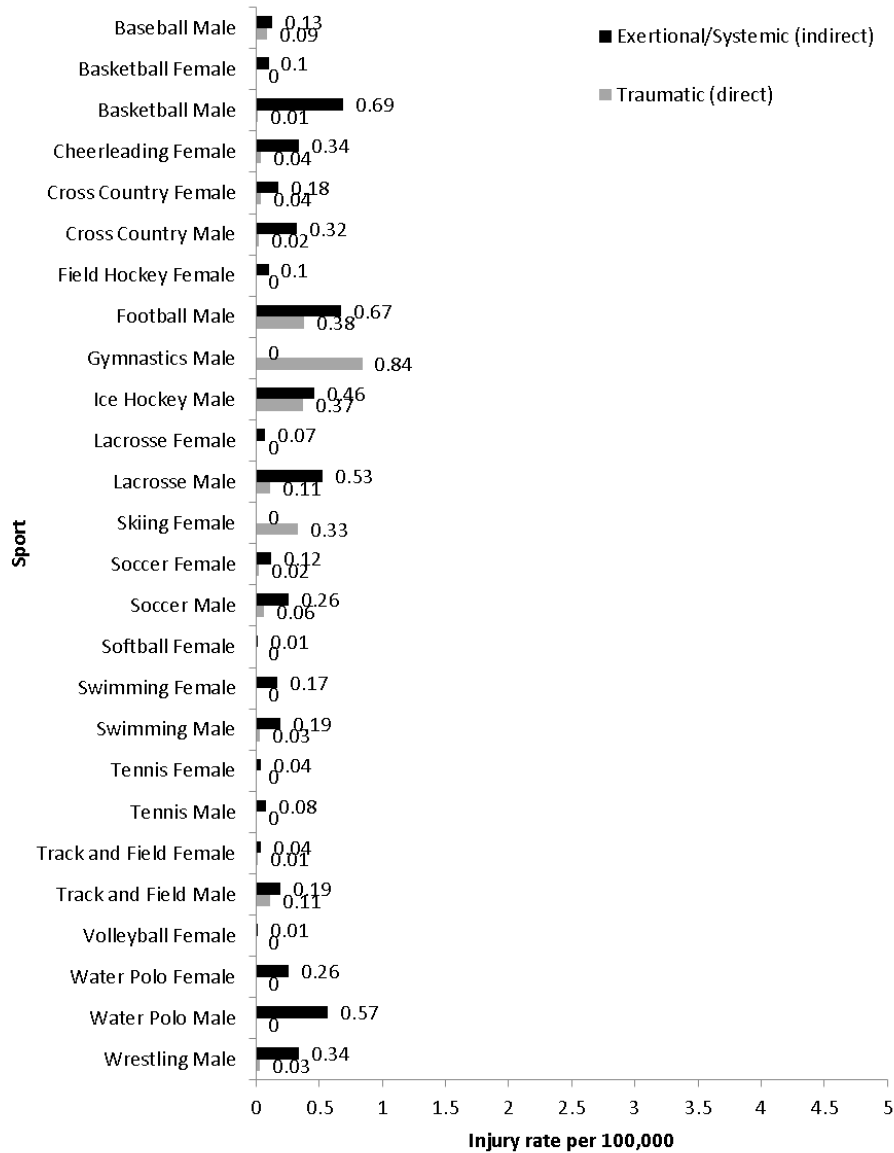
⁴Equestrian (male and female) and rowing (males) are non-championship NCAA collegiate sports.

⁵Includes both indoor and outdoor track and field.

⁶Includes sand volleyball.

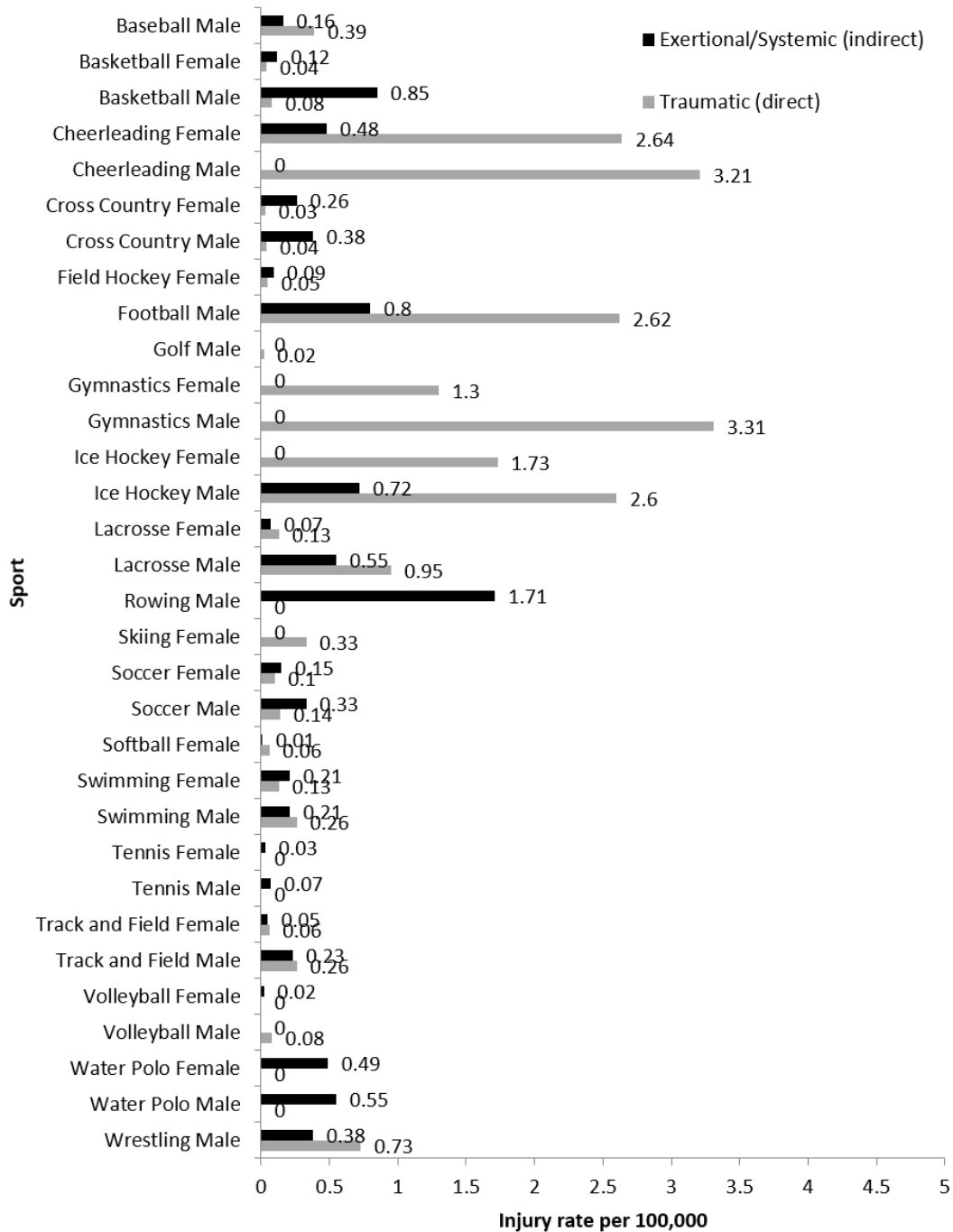
Note: Not all high schools and colleges are members of the NFHS and NCAA. Complete data are not available for the non-member schools. Therefore, these participation numbers underestimate the total number of high school and collegiate participants in the United States.

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



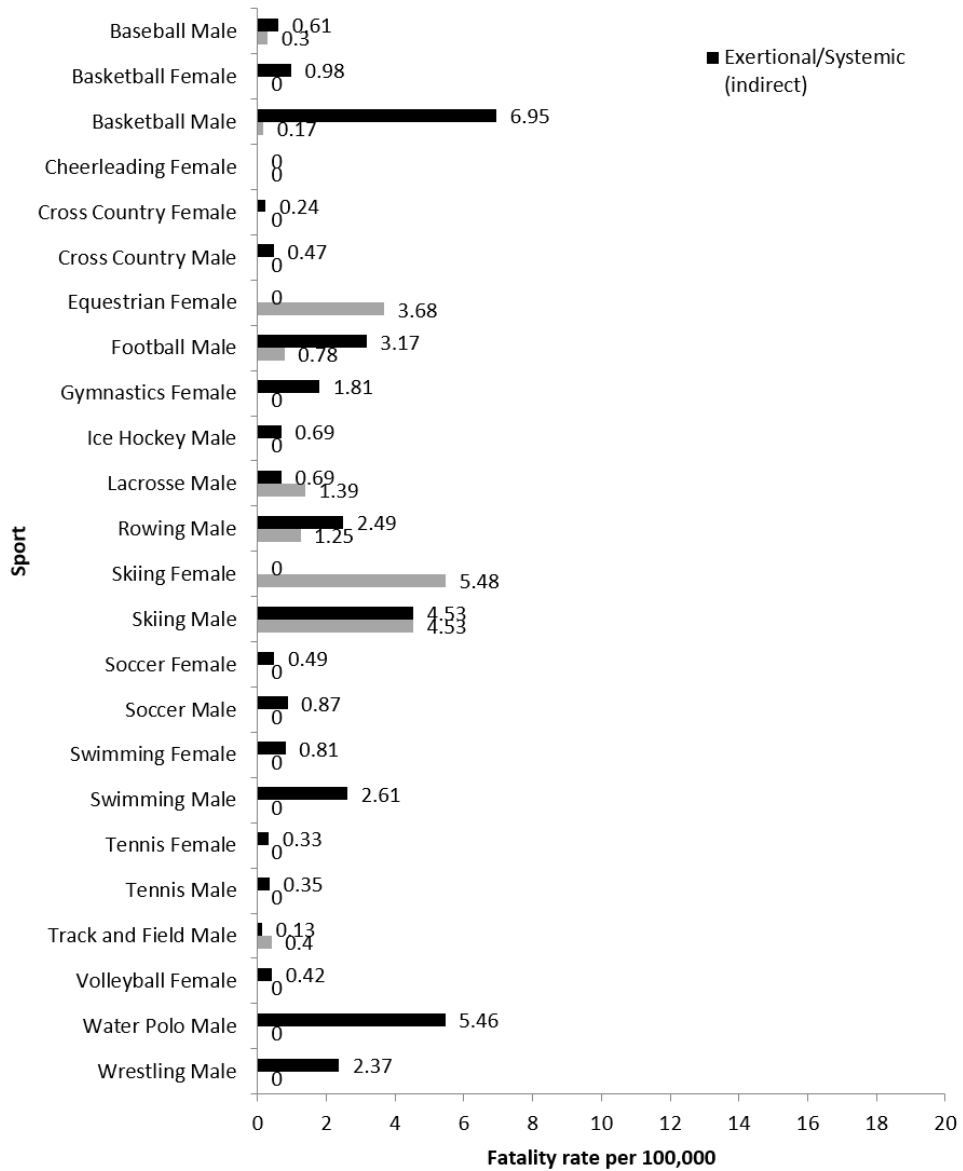
Note: Rates with number of incidents less than 5 should be interpreted with caution.

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



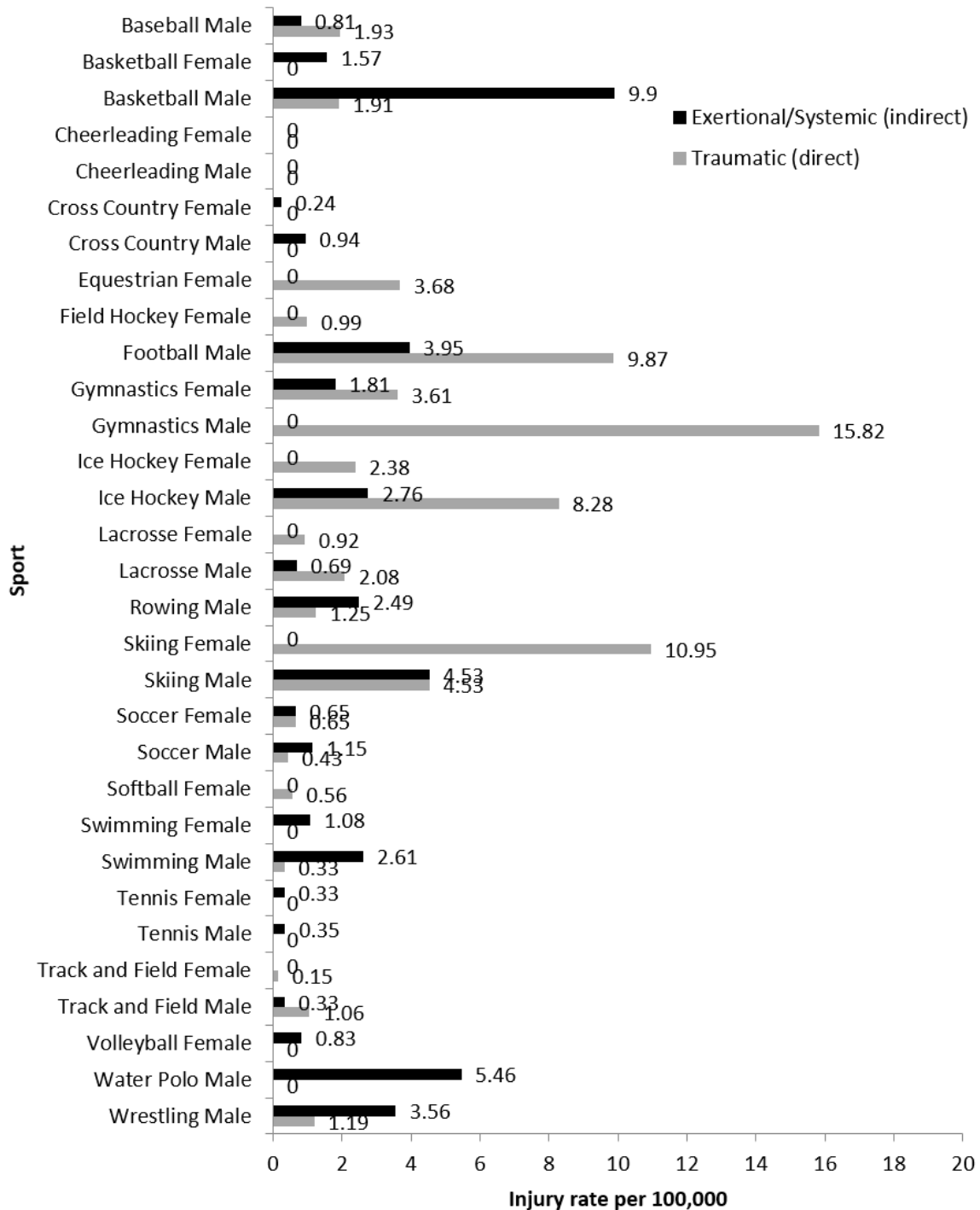
Note: Rates with number of incidents less than 5 should be interpreted with caution.

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.