

# ANNUAL SURVEY OF FOOTBALL INJURY RESEARCH

1931 - 2025

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## INTRODUCTION

In 1931 the American Football Coaches Association initiated the First Annual Survey of Football Fatalities. The original survey committee was chaired by Marvin A. Stevens, M.D., of Yale University, who served from 1931-1942. Floyd R. Eastwood, Ph.D., from Purdue University succeeded Dr. Stevens in 1942 and served through 1964. Carl S. Blyth, Ph.D., of the University of North Carolina at Chapel Hill was appointed in 1965 and served through the 1979 football season. 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. In January 1980, Frederick O. Mueller, Ph.D., from the University of North Carolina at Chapel Hill was appointed by the American Football Coaches Association and the National Collegiate Athletic Association to continue this research under the new title, *Annual Survey of Football Injury Research*.

The primary purpose of the *Annual Survey of Football Injury Research* is to make the game of football safer and, therefore, a more enjoyable sports activity. Because of these surveys, the game of football has realized many benefits in regard to rule changes, improvement of equipment, improved medical care, and improved coaching techniques. The 1976 rule change that made it illegal to make initial contact with the head and face while blocking and tackling was the direct result of this research (Mueller & Cantu 2011).

The 1990 report was historic in that it was the first year since the beginning of the research in 1931 that there was not a direct fatality in football at any level of play (Mueller & Schindler 1991). This illustrates that data collection and analysis is important and plays a major role in injury prevention. 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

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Injury Research (NCCSIR) was established in 1982. The NCCSIR was directed for 30 years by Dr. Frederick Mueller. Dr. Mueller retired Spring of 2013 and the NCCSIR continues under direction of Dr. Kristen Kucera. The NCCSIR has expanded to become a consortium (University of North Carolina, Boston University, University of Washington, University of Connecticut, University of Colorado, the University of Maryland, and the Datalys Center) with expertise in traumatic, cardiac, and exertional-related sport injuries (these three areas account for the overwhelming majority of catastrophic events). The NCCSIR is supported by the American Football Coaches Association (AFCA), the National Collegiate Athletic Association (NCAA), the National Federation of State High School Associations (NFHS), and 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).

## **METHODS**

### **Outcome Definitions**

Football fatalities are classified for this report as direct and indirect. The criteria used to classify football fatalities are as follows:

**Traumatic injury (direct)** – Those fatalities which resulted directly from participation in the fundamental skills of football (e.g. spine fracture).

**Exertional/medical (indirect)** – Those fatalities that are caused by systemic failure as a result of exertion while participating in a football-related activity (e.g. heat stroke, sudden cardiac arrest) or by a complication which was secondary to a non-fatal injury (e.g. infection).

**Non-football and non-exertion related** – Beginning in 2014, NCCSIR is collecting information on suspected cardiac-related deaths in football players but that did not occur during football-related activities (e.g. playing recreational basketball) or exertion (e.g. died in sleep). These events are reported as “non-football or non-exertion related fatalities.” Understanding the etiology and timing of sudden cardiac arrest/death in athletes requires studying events that occurred while the athlete was not physically exerting themselves or during sleep. These events were not included in the tables but are described in Table VII.

### **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, online reports, and professional associates of the researchers. In January of 2015, 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/>). Also in 2015 the NCAA passed legislation in all 3 divisions requiring all sponsored schools to annually report catastrophic sports injuries and conditions. A separate portal was created for school representatives to report these events (<https://www.ncaa.org/sports/2017/9/19/ncaa-catastrophic-sport-injury-reporting.aspx>).

These institution reports are not available for research and were not included in this report.

Throughout the year (January 1 to December 31), upon notification of a suspected football fatality, contact by telephone, email, or personal letter questionnaire was made with the appropriate individuals including state high school association official, school or team administrator, coach, athletic trainer, team physician, and/or the family. Individuals are asked to complete a brief survey about the event at the online portal. Autopsy reports are used when

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available. All activities are approved by the Institutional Review Board (IRB) of the University of North Carolina at Chapel Hill (IRB# 05-0018).

### **Participation in Football**

Reports prior to 2012 showed 1,800,000 participants in all levels of football (Mueller & Colgate 2011). Participation numbers gathered by the National Operating Committee for Standards in Athletic Equipment (NOCSAE), NFHS, and USA Football show the following: there are approximately 1,100,000 high school football participants in grades 9-12. Research also indicates there are 100,000 post high school players including the National Football League (NFL), NCAA, National Association of Intercollegiate Athletics (NAIA), National Junior College Athletic Association (NJCAA), Arena Football, and Semi-professional football. USA Football estimates there are 3,000,000 youth football players in the United States. Sandlot is defined as non-school, youth football, but organized and using full protective equipment (e.g., Pop Warner, American Youth Football League). These figures give an estimate of 4,200,000 total football participants in the United States each year (Mueller & Colgate 2012).

NCCSIR staff in collaboration with NFHS staff compiled and prepared this survey report. Medical data for the report were reviewed by Dr. Robert C. Cantu, MD – medical director of NCCSIR.

### **Analysis**

Yearly frequencies and incidence rates of catastrophic fatalities per 100,000 participants were calculated based on participation estimates as described in the **Participation in Football** section above and stratified by level (organized youth, pro/semi-pro, middle school & high

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school, and college). **Note: 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 report. The report includes data that is reported to the NCCSIR by the NCAA, the NFHS, online reports through the NCCSIR public portal ([sportinjuryreport.org](http://sportinjuryreport.org)), and individuals including athletes, parents, colleagues, coaches, and athletic trainers. Note this report does not include reports submitted by NCAA sponsored schools through the Legislated Catastrophic Injury Portal. There may be additional catastrophic football fatalities that are not reported to the NCCSIR. The authors acknowledge that not every catastrophic fatality is included in this report.

## RESULTS

Overall, NCCSIR captured 11 fatalities among football players of all play levels (4 college, 6 high school, 0 middle school, and 1 youth league). Of these 11 deaths, 0 were directly related to football participation resulting in traumatic injury, 6 were exertional/medical events during football participation (indirect), 1 was unknown if it was directly or indirectly related to football participation, and 4 deaths were non-football or non-exertion related. Of the 11 deaths, at least 9 autopsies were conducted and 7 autopsy reports were available at the time of this report.

Tables, figures, and rates include only the football-related deaths. The overall incidence rate of death during organized football participation (n=7 deaths) was 0.17 per 100,000 players (95% confidence interval: 0.04 to 0.29).

### **Traumatic Injury (Direct) Fatalities**

There were no traumatic injury fatalities directly related to football captured in 2025. (Table I).

Last year in 2024, there were 4 traumatic injury fatalities directly related to football activities captured. Three occurred at the high/middle school level and 1 in college. Three occurred during competition and 1 during practice. All four were traumatic brain injuries.

### **Exertional/Medical (Indirect) Fatalities**

In 2025, there were 6 exertional/medical (indirect) fatalities that occurred among football players during football-related activities (Table II). Five fatalities were at the high school level (2 complications of sickle cell trait, 1 heat stroke, 1 pulmonary embolism, and 1 arteriovenous malformation) and 1 was at organized youth level (sudden cardiac arrest). Two fatalities occurred during practice, 2 during games, and 1 each during a conditioning session and strength/weight session (Table VI). Three (50.0%) occurred during July-August, 2 (33.3%) during Sept-Oct, and 1 (16.7%) during Jan-Feb., The 6 exertional/medical events occurred in 1 offensive lineman and 5 positions were other or unknown.

For the approximately 4,200,000 participants in 2025, the rate of exertional/medical (indirect) fatalities was 0.14 per 100,000 participants (95% confidence interval: 0.03 to 0.26). The rate of exertional/medical (indirect) fatalities in 2025 for high school (grades 9-12) was 0.45 per 100,000 participants (95% confidence interval: 0.06 to 0.85) (Table III). There were no exertional/medical (indirect) fatalities during football activities captured at the college level.

### **Non-Football or Non-Exertion Related Fatalities**

Beginning in 2014, NCCSIR is collecting information on suspected cardiac-related deaths in football players but that did not occur during football-related activities (e.g. playing recreational basketball) or exertion (e.g. died in sleep). Understanding the etiology and timing of sudden cardiac arrest/death in football athletes requires studying events that occurred while the athlete was not physically exerting themselves or during sleep. These events are reported here but not included in Tables and Figures. In 2025 there were 4 non-football or non-exertion related fatalities captured by NCCSIR: all at the middle/high school and collegiate levels. All 4 were sudden cardiac arrest; 3 were during non-athletic activities and 1 was during unaffiliated recreational activity.

### **DISCUSSION**

A total of 11 deaths among football players during calendar year 2025 were collected by NCCSIR: 0 traumatic injury deaths, 6 exertional/medical deaths, 1 death during football participation but unknown cause of death, and 4 non-football/non-exertion related deaths.

There were 0 traumatic injury fatalities directly related to football captured in 2025 compared to 4 traumatic injury fatalities in 2024, 3 in 2023, 3 in 2022, and 4 in 2021. These numbers are not different from the 10-year annual average of 2.7 (2016-2025). Notable during this period, many schools altered, cancelled, or postponed their 2020 fall football season due to COVID-19; 16 states did not play high school football fall of 2020. In addition to fewer teams and players engaged in football activities, player-to-player contact restrictions to reduce COVID-19 transmission may have reduced the frequency and intensity of football contacts during this

period. In addition, some teams played their Fall 2020 competitive season in Spring 2021. This in addition to a Fall 2021 competitive season suggests that some teams played two competitive seasons in calendar year 2021. Incidence rates in Table III were not adjusted for this.

Even though the rate of *direct* traumatic injury fatal injuries is very low on a 100,000 participant basis, the majority occur during competition situations. It should be noted that practices outnumber the number of game exposures because there are typically five practice sessions for every one game and all players participate during practices. This current report illustrates a similar 5-year number of direct traumatic injury fatal events with 13 during 2016-2020 to 14 in 2021-2025 (FIGURE II). Roughly 80% of brain football-related fatalities from 1990 to 2010 occurred during competition (Boden et al. 2013) and recent year's results continue this trend. In 2024, 3 high school football athletes died from catastrophic traumatic brain injuries. **The total number of direct traumatic injury-related deaths in football at all levels of play declined 45% the past 10 years compared to the previous 10 years:** 27 deaths from 2016-2025 (average 2.7 per year) versus 49 deaths from 2006-2015 (average 9 per year). A reduction was observed at the college level. The past 10 years from 2016-2025, there were 3 direct traumatic injury-related deaths in college football compared to 4 deaths the previous 10 years from 2006-2015 – a 25% reduction between the 2 periods. A large reduction was also observed at the high school and middle school level. In the past 10 years from 2016-2025, there were 22 direct traumatic injury-related deaths in high school and middle school football compared to 39 deaths the previous 10 years from 2006-2015 – a 44% reduction between the 2 periods.

There were no fatal traumatic internal organ injuries captured in 2025. Fatal traumatic internal organ injuries are rare (less than one per year captured by NCCSIR); from 1990-2010

NCCSIR recorded three fatal traumatic internal organ injuries in high school football (Boden et al. 2013) and two fatal traumatic internal organ injuries in high school football from 2011 to 2025.

The data illustrates the importance of injury event collection and the analysis of this data in making changes in the game of football that help reduce the incidence of serious injuries. This effort must be continued in order to keep these numbers low and to strive for the minimization of football fatalities.

Exertional/medical (indirect) fatalities have been in double figures on an annual basis for 8 of past 20 years (range 6 in 2025 to 18 in 2009). Since 2000, exertional/medical (indirect) fatalities have outnumbered direct traumatic injury fatalities on average 3 to 1 (FIGURE II). There was one reported death due to exertional heat stroke in 2025—the same as the 1 death in 2024 and 1 death in 2023. Continued safety efforts surrounding practicing in hot weather are urgently needed. There were no reported deaths due to asthma in 2025. During the past 20 years there have been 7 asthma-related deaths in football (3 high school, 3 middle school, and 1 youth level). Cardiac events have been the primary cause of deaths due to exertion (indirect) which is consistent with published research (Harmon et al. 2011). In 2025, there was 1 cardiac-related deaths (youth level). Note: this does not include the 1 death during football activities from unknown causes and 4 non-football or non-exertion related deaths due to sudden cardiac arrest.

The college football level has recorded five fatalities (1 each in 2014, 2016, 2021 and 2 in 2024) due to complications of sickle cell trait since 2010 when regulations were adopted requiring the athlete know their sickle cell trait status and the publication of multiple best practice documents. Deaths associated with sickle cell trait in NCAA Division 1 football players decreased 89% from 2000-2009 to 2010-2020 since the NCAA sickle cell trait testing policy was

passed (Buchanan, et al. 2021). At the high school level there have been 5 deaths due to complications of sickle cell trait since 2010 (1 each in 2015, 2016, and 2020 and 2 in 2025). Boden and colleagues noted 10 exertional sickling deaths recorded from 1998-2018 (Boden, et al. 2021).

Beginning in 2014, NCCSIR has been collecting information on non-football/non-exertion related fatalities that are suspected to be cardiac-related in order to improve our understanding of the etiology of cardiac-related events and how to prevent sudden cardiac arrest in competitive athletes. NCCSIR captured 31 non-football/non-exertion related fatalities from 2021-2025 and 27 were due to sudden cardiac arrest. It is important to capture these events because it almost doubled the number of athletes that died due to cardiac-related causes within the 5-year period (i.e. 30 during exertion plus 23 non-exertional for total of 53 cardiac events).

### **Head and Neck Injuries**

In 2025, there were no direct fatalities in football compared to 4 in 2024, all of which were the result of traumatic brain injury. The 10-year period of 2016-2025 recorded 25 head and neck football fatalities (Table VIII and Figure I). There have been fewer than 10 head and neck fatalities per year for the past twenty-five years (Cantu & Mueller 2002; Boden et al. 2013). Rule changes beginning in the 1976 football season that eliminated the head and face as a primary and initial contact area for blocking and tackling were of utmost importance. The original 1976 rule defined spearing as “the intentional use of the helmet (including the face mask) in an attempt to punish an opponent.” In 2005 “intentional” was dropped from the rule: “spearing is the use of the helmet (including the face mask) in an attempt to punish an opponent”. A 2006 point of emphasis covered illegal helmet contact and defined spearing, face

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tackling, and butt blocking. Butt blocking, face tackling, and spearing were defined as “Helmet Contact – Illegal” to place more emphasis on risk-minimization concerns (NFHS Football Rules Book 2014). Examples of illegal helmet contact that could result in disqualification include illegal helmet contact against an opponent lying on the ground, illegal helmet contact against an opponent held up by other players, and illegal helmet-to-helmet contact against a defenseless opponent. In 2014 the NFHS further defined illegal contact to include “targeting” or “an act of taking aim and initiating contact to an opponent above the shoulders with the helmet, forearm, hand, fist, elbow or shoulders” (NFHS Football Rules Book 2014, rule 2-20-2, pg. 31). In 2015, spearing was further defined as “an act by any player who initiates contact against an opponent at the shoulders or below with the crown (top portion) of his helmet” (NFHS Football Rules Book 2015, rule 2-20-1c, pg. 31).

Head first/head down contact was identified as contributing to eight of the 28 deaths captured in high school and college football from 2005-2014 (Kucera et al. 2017). This emphasizes the importance of instruction in proper tackling techniques (both delivery and receipt of tackles) for all players, but particularly for running backs, linebackers, and defensive backs. Football is a collision sport played at high velocity, and players must act and react quickly. In such situations, new techniques might be difficult to deploy, resulting in players possibly reverting to past behaviors and reactions unless coaches routinely intervene to correct their technique (Kucera et al. 2017). Coaches who do not correct improper tackling and blocking techniques are placing their players at risk for permanent paralysis or death. Football officials who do not penalize players for this type of tackling and blocking are placing players at risk. This type of tackling and blocking technique was the direct cause of 36 football fatalities and 30 permanent paralysis injuries in 1968. Since 1960 most of the direct fatalities were the result of

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brain and neck injuries. Since 1990, 90% of brain and cervical spine deaths have been brain injuries. Continuing to reduce head and neck injuries in the sport is paramount.

Another important effort has been and continues to be the improvement of football protective equipment. The helmet technical standard established by the National Operating Committee on Standards for Athletic Equipment (NOCSAE) was adopted by the NCAA in 1978 and by the NFHS in 1980 and likely contributed to the decrease in football-related direct fatalities. Beginning in June 2018, all manufacturers of football helmets have to meet a new NOCSAE standard that includes rotational forces (maximum of 6,000 radians per second squared) if they are to be certified. This change was to address concussion risks. It is imperative that helmets be purchased, fitted, and properly reconditioned by manufacturer standards. Coaches should follow the manufacturer's recommendations for fitting, replacement, and reconditioning. In addition, helmets 10 years or older will not be reconditioned or returned to the team per the guidelines established by the NAERA (National Athletic Equipment Reconditioners Association). More recently soft shell helmet covers are being worn over the hard shell helmet during practice by some teams at professional, collegiate, and high school levels. Recent research among high school football players found no difference in practice concussion rates between players that used a soft shell cover and those that did not (Hammer, et al. 2025). It is not clear whether use of soft shell covers is effective at reducing concussion rates during games nor whether use impacts incidence of catastrophic head and brain injuries. Manufacturers, coaches, athletic trainers, athletes, and physicians should continue their joint and individual efforts in preventing head and neck trauma.

The authors of this research report acknowledge that the current rules which limit the use of the head in blocking and tackling, coaches teaching the proper fundamentals of blocking and

tackling, the helmet technical standard established by NOCSAE, excellent player physical conditioning, proper medical intervention and care, and an independent data collection system have played a significant role in reducing fatalities and serious brain and neck injuries in football. However, the football community should continue their efforts to reduce the number of head and neck injuries.

Several suggestions for reducing, identifying, and managing head and neck injuries are as follows:

1. **Conditioning:** Athletes must be given proper conditioning exercises that will strengthen bodies to withstand the workloads and energy expenditure throughout the game given their positions and time played. Strengthening their necks in order to hold their heads in proper position when tackling and to absorb impact energy to control head movement is important. Players should also have appropriate flexibility and range of motion of the shoulder and neck complex. These preparatory activities can provide the athlete with the ability sustain good tackling and athletic skills throughout the game situations.
2. **Skills:** Coaches should teach and drill the athletes in the proper execution of the fundamental skills, particularly blocking and tackling. Players should keep their head up while tackling and running with the ball. Contact should never be initiated with the top or crown of the head/helmet. Initial contact should never be made with the head/helmet or face mask. Research is needed to analyze the mechanisms of impacts during competitions that lead to fatal and catastrophic events.
3. **Rules:** Rules are in place to protect defenseless players, the tackler initiating contact, and the ball carrier. Coaches and game officials should discourage the players from

using their helmets in initiating contact when blocking and tackling. The rules prohibiting spearing should be enforced in practice and in games. The players should be taught and held accountable through the rules of play, video sessions, and on the practice field to respect the helmet as a protective device and that the helmet should not be used to initiate contact or as a weapon.

4. **Equipment:** All coaches, equipment managers, athletic trainers, and physicians should take special care to see that players equipment is properly fitted, particularly the helmet. Players should be educated about the use and care of the helmet and other protective equipment and adhere to proper fit guidelines and proper use as outlined by the manufacturer.
5. **Limiting Contact:** Recently national and state high school associations have recommended limiting both the frequency and duration of full contact in football practices (NFHS 2014). As of 2019 an Associated Press survey reported at least 43 state high school associations had enacted policies to limit time and/or days of full-contact football practices (Lage 2019; Straus 2016). Recent research noted a 57% decrease in high school football concussion rates during practice after state athletic association contact limit restrictions were adopted (Pfaller, et al. 2019). Similarly, higher concussion rates were observed during preseason and during fully padded, live contact practices in college football supporting reduced contact as a means to reduce concussions (McCrea, et al. 2021; Wasserman, et al. 2020).
6. **Brain Injury and Concussion:** A brain injury, including concussions, can be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head. This sudden impact or movement of the brain

can cause stretching and tearing of brain cells, damaging the cells and create chemical changes in the brain.

- a. Signs & Symptoms: When a player has experienced or shown signs and symptoms of head trauma (such as a change in the athlete's behavior, thinking, or physical functioning), they should receive immediate medical attention from an appropriate medical provider and should not be allowed to return to practice or game without an evaluation by an appropriate medical provider and permission from a physician if diagnosed with a brain injury.
- b. Reporting & Care: 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/index.html>

- c. Management & Return to Play: Medical staff must have the unchallengeable authority to assess and make medical decisions for head injuries. Coaches should never make the decision whether a player has a concussion or return the player back to a game or active participation in a practice if that player is experiencing signs or symptoms of brain trauma. In rare cases, an athlete who has not recovered from a concussion and

returned to play and receives another severe hit can experience second impact syndrome.

- d. Policies: All athletes and athletic personnel should follow the state, NFHS, NCAA, or NFL policies related to concussion prevention, identification, management, and return to play depending on their level of play. See this CDC resource above for more information: <https://www.cdc.gov/heads-up/guidelines/index.html>

For the most up to date information on concussion management please refer to the updated Consensus Statement on Concussion in Sport: the 6<sup>th</sup> International Conference on Concussion in Sport held in Amsterdam, October of 2022 (Patricios et al. 2023 available at <https://bjsm.bmj.com/content/57/11/695>).

Over the last decade, sport governing bodies have adopted new or modified playing rules for football to protect defenseless players, remove targeting from the game, eliminate dangerous play, and stoppage of play for injured players to ensure medical care can be accessed for injuries. In addition, these same governing bodies have published best practices for prevention, recognition, management and return to play for athletes with suspected concussion, spine and brain injuries. Member institutions of these organizations should implement these best practices.

NFHS rules changes affecting risk, (1982-2024). Available at: <https://a-us.storyblok.com/f/1022696/x/ac1f4cded8/1982-2025-nfhs-risk-minimization-rules-final.pdf>

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NCAA rules for football are available at:

<https://ncaapublications.com/products/2025-ncaa-football-rules-book>

NCAA Football Practice Guidelines: Year-Round Football Practice Contact Guidelines (<http://www.ncaa.org/health-and-safety/football-practice-guidelines>). *The Safety in College Football Summit*. Inter-association consensus guidelines for three paramount safety issues in collegiate athletics:

1. Independent medical care in the collegiate setting
2. Concussion diagnosis and management
3. Football practice contact.

NFL timeline of rule changes related to health and safety. Available at:

<https://www.nfl.com/playerhealthandsafety/equipment-and-innovation/rules-changes/nfl-health-and-safety-related-rules-changes-since-2002>

### **Exertional Heat Stroke**

A continuous effort should be made to eliminate exertional heat stroke deaths associated with football. From 1966 through 2025 there have been 138 exertional heat stroke events that resulted in death (Table IV). **Exertional heat stroke deaths are preventable with the proper precautions, early recognition, and emergency management.** Since 1996, 73 football players have died from exertional heat stroke (53 high school, 15 college, 2 professional, 2 organized youth, and 1 middle school). During the most recent five-year period from 2021-2025, there were 7 deaths for an average of 1.4 exertional heat stroke deaths per year—less than the 12 deaths for an average of 2.4 per year during the previous five-year period 2016-2020. The number of

exertional heat stroke deaths supports urgent efforts to educate coaches, school administrators, medical providers, players, and parents concerning the proper procedures and precautions when practicing or playing in the heat. **Comparing the most recent 2 five-year periods:**

- **Of the 7 exertional heat stroke deaths 5 were during practice, 1 during conditioning activities and 1 during games in 2021-2025 compared to 7 of 12 during conditioning and 5 during practice in 2016-2020.**
- **Of the 12 known player positions, all exertional heat stroke deaths were among lineman positions: 4 of 4 in 2021-2025 and 8 of 8 in 2016-2020.**

**This highlights the urgent need for appropriate oversight and monitoring of conditioning sessions and additional precautions for lineman positions which have been outlined in a recent clinical review (Anderson et al. 2024).** In a recent position statement the NCAA outlined recommendations for conditioning sessions that include: transition periods, acclimatization, conditioning session activities are evidence-based, monitored and approved by credentialed strength and conditioning professionals or the head coach, performed in locations defined in the emergency action plan, and modifiable in hazardous environmental conditions (Parsons, et al. 2020) (direct link to report:

[https://ncaaorg.s3.amazonaws.com/ssi/injury\\_prev/SSI\\_PreventingCatastrophicInjuryBooklet.pdf](https://ncaaorg.s3.amazonaws.com/ssi/injury_prev/SSI_PreventingCatastrophicInjuryBooklet.pdf)

f). It is important to note that in addition to the 19 exertional heat stroke deaths the last ten years, there was one death that was a result of an athlete *over-hydrating* in order to prevent heat-related issues. Prevention messages must go beyond hydrating but emphasize how to properly hydrate, how to acclimate to the environment, how to acclimate to the addition of equipment, and achieve the appropriate fitness baseline for the intended rigors of practice.

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 with recommendations for prevention

(<https://www.nata.org/sites/default/files/externalheatillnesses.pdf>; Casa et al., 2015). When football activity is carried on in hot weather, the following suggestions and precautions should be taken:

1. **Pre-Participation Physicals:** Each athlete should have a complete physical examination with a medical history and an annual health history update. History of previous heat illness, general illness, sickle cell trait, supplements, medications, and type of training activities before organized practice begins should be included.
2. **Acclimatization:** Acclimatize athletes to increasing exercise intensity, equipment, and hot/humid environments gradually by providing progressive practice sessions for the first fourteen days of football preseason and any other subsequent practice in hot or humid days. States and governing bodies have rules pertaining to when full football uniforms may be worn. See recent NCAA statement on preventing sudden death in sport for acclimatization recommendations:  
[https://ncaaorg.s3.amazonaws.com/ssi/injury\\_prev/SSI\\_PreventingCatastrophicInjuryBooklet.pdf](https://ncaaorg.s3.amazonaws.com/ssi/injury_prev/SSI_PreventingCatastrophicInjuryBooklet.pdf)
3. **Monitoring Environmental Conditions:** Know both the temperature and the humidity since it is more difficult for the body to cool itself in high humidity. Anytime the wet-bulb temperature is over 82 degrees Fahrenheit (28 degrees Celsius) suggests that careful control of all activity should be undertaken. Additional precautions should be taken when wearing protective equipment. The ACSM, NATA,

NFHS, and NCAA have all published guidelines for conducting athletic activities in hot and humid environments.

4. **Adjust Activity Levels:** The intensity of exercise is the leading factor that can increase core body temperature higher and faster than any other. Workouts should be activity and position specific and should never be punitive (used for punishment) (Boden et al. 2020). Adjusting activity level and providing frequent rest periods can minimize the risk of heat illness in football. Minimize multiple practice sessions during the same day and allow at least three hours of recovery between sessions. Rest during workouts in cool, shaded areas with some air movement and remove helmets and loosen or remove jerseys.
5. **Hydration:** Fluids should be readily available and consumed to aid in the body's ability to regulate itself and reduce the impact of heat stress in practice and games. Players should have water available and be encouraged to drink to minimize dehydration throughout a practice session. Athletes should drink water before, during, and after practice. Athletes are also encouraged to weigh in before and after exercise to establish individualized hydration plan to prevent excess dehydration and over-drinking. Sports drinks that contain sodium (salt) and potassium can be consumed to replace electrolytes lost during activity.
6. **Monitor Athletes:** Athletes should weigh each day before and after practice and weight charts checked in order to treat the athlete who loses excessive weight each day. Generally, athlete should return to their previous day's weight before practicing.
7. **Clothing & Equipment:** Clothing is important and a player should wear moisture wicking apparel to dissipate heat. Never use rubberized clothing or sweat suits.

8. **Identify At-Risk:** Some athletes are more susceptible to heat injury. These individuals are not accustomed to physical activity in the heat, may be overweight, ill with a fever or other medical condition, and may be the eager athlete who constantly competes at his maximum capacity without heeding warning signs. Athletes with previous heat problems should be monitored.
9. **Emergency Action Plan:** Sports teams should have written emergency procedures in place, all personnel should have copies, and procedures should be reviewed annually. The CDC has guidelines and templates for these plans (<http://www.cdc.gov/niosh/docs/2004-101/emrgact/emrgact1.html>). NFHS have guidelines for these plans at the following websites:
- Position Statement and Recommendations for Maintaining Hydration to Optimize Performance and Minimize the Risk for Exertional Heat Illness <https://a-us.storyblok.com/f/1022696/x/fd2b8d7658/nfhs-hydration-position-statement-final-10-6-25.pdf>
  - Heat Acclimatization and Heat Illness Prevention Position Statement <https://a-us.storyblok.com/f/1022696/x/42da7079ed/heat-acclimatization-and-heat-illness-prevention-position-statement-final-10-6-25.pdf>
10. **Heat Illness:**
- a. **Signs & Symptoms:** It is important to observe for signs of heat illness. Some trouble signs are nausea, incoherence, fatigue, weakness, vomiting, cramps, weak rapid pulse, flushed appearance, visual disturbances, and unsteadiness. Exertional heat stroke

victims, contrary to popular belief, may sweat profusely as athletes are exercising. If heat illness is suspected, seek immediate medical service.

- b. Recognition & Care: 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. First aid should include removal from activity, taking off all equipment and placing the student-athlete in a cool, shaded environment. Fluids should be given orally. Core temperature and vital signs should be serially assessed. The student-athlete should be cooled by ice immersion and ice towels. Use of IV fluid replacement should be determined by a physician. Some schools have plastic outdoor tubs or swim pools filled with ice water available at practice facilities in hot and humid environments. Tarp-Assisted Cooling with Oscillation (TACO) cooling method is a low-cost evidence-informed practice alternative to cooling tubs (Luhning, et al. 2016). Best practices emphasize core temperature measured rectally as most reliable measure of core body temperature. Reducing core temperature and minimizing the duration of hyperthermia is essential in reducing the risk of potential organ damage or death (i.e., "Cool First, Transport Second") (Casa et al. 2015).

### **Sudden Cardiac Death**

Given the significant number of exertional/medical (indirect) cardiac related events 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 are critical for survival (3-5 minutes recommended, Casa et al. 2012).

1. See Drezner et al. 2007 for additional information about sudden cardiac arrest preparedness and management: <https://www.nata.org/sites/default/files/2025-08/sudden-cardiac-arrest-consensus-statement.pdf>
2. The following video produced by University of Washington Center for Sports Cardiology illustrates how to expose the chest and perform CPR/AED in a football player with pads: <https://www.nfl.com/playerhealthandsafety/resources/for-medical-professionals/recognize-react-rescue-effectively-treating-sudden-cardiac-arrest>.
3. The following video “AEDs for Athletes: Preparedness, Education, Action – Training for High School Students” produced by The NFHS Foundation illustrates how high school students can respond during a sudden cardiac arrest: <https://www.youtube.com/watch?v=J73ZJHJrd3I>

### **Deaths Among Athletes with Sickle Cell Trait**

There is concern over the past 20 years for exertional deaths in football players with sickle cell trait. Many athletes do not know their sickle cell status even though screening is done at birth. The NCAA mandates that all student-athletes know their sickle cell trait status or seek testing to confirm their status with a physician. An 89% reduction in sickle cell trait associated death was observed in Division 1 football after NCAA sickle cell trait screening policy in 2010 (Buchanan, et al. 2021). The NATA supports this concept with their statement Consensus Statement: Sickle Cell Trait and the Athlete available at: <https://www.nata.org/sites/default/files/2025-08/sicklecelltraitandtheathlete.pdf> (Inter-Association Task Force on Sickle Cell Trait and the

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Athlete, 2007). The statement includes precautions for athletes with sickle cell trait. Recently a diverse group of researchers, practitioners, athletics professionals, athletes, decision-makers, and other interested parties met in a 2-part summit to discuss and formulate recommendations, rationales, and strategies around screening for sickle cell trait in NCAA athletics. The final report from this summit is available to anyone at the following link:

<https://duke.app.box.com/s/mw8fy36oqtzozacl9skur5uyduzwi3vs>.

## **RECOMMENDATIONS**

1. Mandatory medical examinations and medical history should be passed before allowing an athlete to participate in football. The NCAA requires a thorough medical examination when the athlete first enters the college athletic program and an annual health history update with use of referral exams when warranted. If the physician or coach has any questions about the athlete's readiness to participate, the athlete should not be allowed to play. High school coaches should follow the recommendations set by their State High School Association. Most state associations require the use of their own medical examination form.
2. All personnel involved with training football athletes should emphasize proper, gradual, and sport-specific physical conditioning appropriate for the activities of the player position and should never be punitive (used as punishment).
3. Emergency measures must be in place for all games and practice sessions. Each school should have a venue-specific, written emergency action plan (EAP) in place, all personnel should have copies, and procedures should be reviewed and practiced annually.

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- The NATA position statement (Scarneo-Miller et al. 2024) has published guidelines for these plans: [https://www.nata.org/sites/default/files/2025-08/emergency\\_action\\_plan\\_development.pdf](https://www.nata.org/sites/default/files/2025-08/emergency_action_plan_development.pdf)
  - 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>).
  - The NFHS has guidelines for these plans and educational resources here:  
<https://assets.nfhs.org/umbraco/media/7213372/nfhs-smac-emergency-action-plans-eap-position-statement-final-10-7-24.pdf>  
<https://nfhslearn.com/courses/emergency-action-planning-for-afterschool-programs>
  - NCAA has guidelines for these plans at [www.ncaa.org](http://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.
  - In addition to emergency action plans, pregame emergency plan review meetings (“medical time out”) with all relevant coaching, venue, medical, and emergency staff ensure optimal readiness and that all relevant staff know their role in an emergency (Courson et al. 2024; NCHSAA 2019). Examples of pregame meeting reports can be found here: [https://coachesinsider.com/wp-content/uploads/2022/03/NCHSAA\\_Pre-game\\_EAP\\_Review\\_Report.pdf](https://coachesinsider.com/wp-content/uploads/2022/03/NCHSAA_Pre-game_EAP_Review_Report.pdf) and <https://bjsm.bmj.com/content/bjsports/58/14/763/DC1/embed/inline-supplementary-material-1.pdf?download=true>
4. Each institution should strive to have access to a certified athletic trainer. Whenever possible certified athletic trainers should be present for all football practices and

- games. Whenever possible physicians should be onsite or accessible for all practices and onsite for all games.
5. All individuals, groups and organizations interested in sport safety should continue their efforts and collaborations to ensure the safety of football for all participants.
  6. There should be strict enforcement of game rules, and administrative regulations should be enforced to protect the health of the athlete. Coaches and school officials must support the game officials in their conduct of the athletic contests.
  7. There should be a renewed emphasis on employing well-trained athletic personnel, providing excellent facilities, and securing the safest and best equipment possible.
  8. There should be continued research concerning the safety of football players in practice and games (rules, facilities, equipment, etc.).
  9. Coaches should continue to teach and emphasize the proper fundamentals of blocking and tackling to help reduce brain and neck fatalities. KEEP THE HEAD OUT OF FOOTBALL.
  10. Strict enforcement of the rules of the game by both coaches and game officials will help reduce serious injuries. Be aware of the rules from respective governing associations concerning illegal helmet contact, defenseless players, and targeting.
  11. When a player has shown signs or symptoms of head trauma, the player should receive immediate medical attention from an appropriate medical provider and should not be allowed to return to practice or game without permission from a physician if diagnosed with a brain injury. All athletes and athletic personnel should follow the state, NFHS, NCAA, or NFL policies related to concussion prevention, identification,

management, and return to play depending on their level of play. See discussion section in report on Head and Neck Injuries.

12. Given the significant number of cardiac-related deaths each year, it is recommended that schools have an emergency action plan that is reviewed and rehearsed annually. Automated external defibrillators (AED) should be available for emergency situations (within three minutes). The following video produced by University of Washington Center for Sports Cardiology illustrates how to expose the chest and perform CPR/AED in a football player with pads:  
<https://www.nfl.com/playerhealthandsafety/resources/for-medical-professionals/recognize-react-rescue-effectively-treating-sudden-cardiac-arrest>. See discussion section in report on Sudden Cardiac Arrest.
13. All personnel associated with football 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. Best practices for management of exertional heat stroke emphasize reducing core temperature and minimizing the duration of hyperthermia as essential in reducing the risk of potential organ damage or death (i.e., "Cool First, Transport Second") (Casa et al. 2015). See discussion section in report on Exertional Heat Stroke.
14. Consistent with the NATA and NCAA, it is recommended that athletes know their sickle cell status prior to participation in sports. In turn this information should be shared with sports medicine and athletic staff so that evidence-based precautions can

be implemented to ensure safe participation. See discussion section in report on Deaths in Athletes with Sick Cell Trait for additional information.

## REFERENCES

- Anderson, S. A., Eichner, E. R., Bennett, S., Boden, B. P., Colgate, B., Courson, R., Davis, J. K., et al. (2024). Preventing exertional heat stroke in football: time for a paradigm shift. *Sports health*, 19417381241260044.
- Boden, B.P., Breit, I., Bechler, J.A., Williams, A., & Mueller, F. O. (2013). Fatalities in High School and College Football Players. *Am J Sports Med*, 41(5):1108-16.
- Boden, B. P., Fine, K. M., Breit, I., Lentz, W., & Anderson, S. A. (2020). Nontraumatic Exertional Fatalities in Football Players, Part 1: Epidemiology and Effectiveness of National Collegiate Athletic Association Bylaws. *Orthopaedic Journal of Sports Medicine*, 8(8), 2325967120942490. <https://doi.org/10.1177/2325967120942490>
- Buchanan, B. K., Siebert, D. M., Zigman Suchsland, M. L., Drezner, J. A., Asif, I. M., O'Connor, F. G., & Harmon, K. G. (2020). Sudden Death Associated With Sick Cell Trait Before and After Mandatory Screening. *Sports Health*, 12(3), 241–245. <https://doi.org/10.1177/1941738120915690>
- Cantu, R.C. & Mueller, F.O. (2002). Brain Injury-Related Fatalities in American Football, 1945-1999. *Neurosurgery* 52:846-853.
- Casa, D., J. DeMartini, M. Bergeron, D. Csillan, E. Eichner, R. Lopez, M. Ferrara, K. Miller, F. O'Connor, M. Sawka and S. Yeargin (2015). National Athletic Trainers' Association position statement: Exertional heat illness. *Journal of Athletic Training* 50(9): 986-1000.
- Casa, D., Guskiewicz, K., Anderson, S., Courson, R., Heck, J., Jimenez, C., et al. (2012). National athletic trainers' association position statement: preventing sudden death in sports. *Journal of Athletic Training*, 47(1), 96-118.
- Lage, L. AP survey: most states limit full contact for HS football. *AP*. Published August 30, 2019. Accessed March, 9 2026. <https://apnews.com/article/e525659c28734de98da719a110893d21>

Straus, L. NFHS Recommendation To Limit Full-Contact Practices In High School Football Adopted By Most States. Head Injury Safety Center. Published November 12, 2014. Updated August 26, 2016. Accessed March 9, 2026. <https://concussions.smart-teams.org/nfhs-recommendation-to-limit-full-contact-practices-in-high-school-football-adopted-by-most-states/2/>

Courson, R., Henry, G., Borque, K., Casa, D. J., Collins, M. S., Eason, C., Elkins, G., et al. (2024). Pre-event “medical time out”. *British Journal of Sports Medicine*, 58(14), 763–765.

Hammer, E., Mosiman, S., Joachim, M. R., Taylor, E., Cordum, A., Brooks, M. A., & McGuine, T. (2025). The association between Guardian Cap use during practices and sport-related concussion risk in high school American football players. *British Journal of Sports Medicine*, 59(4), 257–262.

Harmon, K.G., Asif, I.M., Klossner, D., & Drezner J.A. (2011). Incidence of Sudden Cardiac Death in National Collegiate Athletic Association, *Circulation*, 123(15):1594-600.

Harmon, K.G., Drezner, J.A., Klossner, D., & Asif I.M. (2012). Sick cell trait associated with a RR of death of 37 times in National Collegiate Athletic Association football athletes: a database with 2 million athlete-years as the denominator. *British Journal of Sports Medicine*, 46(5):325-30.

Harris, K. M., T. S. Haas, E. R. Eichner and B. J. Maron (2012). Sick Cell Trait Associated With Sudden Death in Competitive Athletes. *The American Journal of Cardiology* 110(8): 1185-1188.

Inter-Association Task Force on Sick Cell Trait and the Athlete. (2007). Consensus Statement: Sick Cell Trait and the Athlete (pp. 5). Dallas, TX: National Athletic Trainers’ Association.

Investigating Sick Cell Trait Screening in the NCAA: Study Report and Recommendations. Study and Summit Report, 2025, pp. 17. Link: <https://duke.app.box.com/s/mw8fy36oqtzozac19skur5uyduzwi3vs>

Kucera, K.L., Yau, R.K., Register-Mihalik, J., Marshall, S.W., Thomas, L.C., Wolf, S., Mueller, F.O., Cantu, R., Guskiewicz, K (2017). Traumatic Brain and Spinal Cord Fatalities Among High School and College Football Players — United States, 2005–2014. *MMWR Morbidity Mortality Weekly Report* 65:1465–1469. DOI: <http://dx.doi.org/10.15585/mmwr.mm6552a2>.

Luhning, K. E., Butts, C. L., Smith, C. R., Bonacci, J. A., Ylanan, R. C., Ganio, M. S., & McDermott, B. P. (2016). Cooling Effectiveness of a Modified Cold-Water Immersion Method After Exercise-Induced Hyperthermia. *Journal of Athletic Training*, 51(11), 946–951. <https://doi.org/10.4085/1062-6050-51.12.07>

McCrea, M. A., Shah, A., Duma, S., Rowson, S., Harezlak, J., McAllister, T. W., ... Stemper, B. D. (2021). Opportunities for prevention of concussion and repetitive head impact exposure in

college football players: A concussion assessment, research, and education (CARE) consortium study. *JAMA Neurology*. doi:10.1001/jamaneurol.2020.5193. Epub ahead of print. PMID: 33523101; PMCID: PMC7851752.

Mueller, F.O. & Cantu, R.C. (2011). *Football Fatalities & Catastrophic Injuries, 1931-2008*. Carolina Academic Press. Durham, NC.

Mueller, F.O. & Schindler, R.D. (1991). *Annual Survey of Football Injury Research: 1931-1990*. American Football Coaches Association, National Collegiate Athletics Association, & National Federation of State High School Associations. Waco, TX, Indianapolis, IN.

Mueller, F.O. & Colgate, B. (2011). *Annual Survey of Football Injury Research: 1931-2010*. American Football Coaches Association, National Collegiate Athletics Association, & National Federation of State High School Associations. Waco, TX, Indianapolis, IN.

Mueller, F.O. & Colgate, B. (2012). *Annual Survey of Football Injury Research: 1931-2011*. American Football Coaches Association, National Collegiate Athletics Association, & National Federation of State High School Associations. Waco, TX, Indianapolis, IN.

Mueller, F.O. & Colgate, B. (2013). *Annual Survey of Football Injury Research: 1931-2012*. American Football Coaches Association, National Collegiate Athletics Association, & National Federation of State High School Associations. Waco, TX, Indianapolis, IN.

National Federation of State High School Associations 2014 NFHS Football Rules Book, Robert B. Gardner (publisher) and Bob Colgate (Editor). Indianapolis, IN. pp 112.

National Federation of State High School Associations 2015 NFHS Football Rules Book, Robert B. Gardner (publisher) and Bob Colgate (Editor). Indianapolis, IN. pp 119.

Parsons, J. T., S. A. Anderson, D. J. Casa and B. Hainline (2020). Preventing catastrophic injury and death in collegiate athletes: Interassociation recommendations endorsed by 13 medical and sports medicine organisations. *British Journal of Sports Medicine* 54(4): 208-215.

Patricios, J. S., Schneider, K. J., Dvorak, J., Ahmed, O. H., Blauwet, C., Cantu, R. C., Davis, G. A., et al. (2023). Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *British Journal of Sports Medicine*, 57(11), 695–711. (direct link: <https://bjsm.bmj.com/content/57/11/695>)

Pfaller, A. Y., Brooks, M. A., Hetzel, S., & McGuine, T. A. (2019). Effect of a New Rule Limiting Full Contact Practice on the Incidence of Sport-Related Concussion in High School Football Players. *The American Journal of Sports Medicine*, 47, 2294–2299. doi: 10.1177/0363546519860120.

Scarneo-Miller, S. E., Hosokawa, Y., Drezner, J. A., Hirschhorn, R. M., Conway, D. P., Elkins, G. A., Hopper, M. N., et al. (2024). National athletic trainers' association position statement:

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emergency action plan development and implementation in sport. *Journal of Athletic Training*, 59(6), 570–583.

Wasserman, E. B., Coberley, M., Anderson, S., Grant, M., & Hardin, J. A. (2020). Concussion Rates Differ by Practice Type and Equipment Worn in an Autonomy Five Collegiate Football Conference. *Clinical journal of sport medicine: official journal of the Canadian Academy of Sport Medicine*, 30(4), 366–371. <https://doi.org/10.1097/JSM.0000000000000615>

**TABLE I. TRAUMATIC INJURY (DIRECT) FATALITIES DIRECTLY DUE TO FOOTBALL - 1931-2025<sup>1,4</sup>**

<b>Year</b>	<b>Organized youth Direct</b>	<b>Pro &amp; Semi-pro Direct</b>	<b>Middle &amp; High School Direct</b>	<b>College Direct</b>	<b>Total Direct</b>
1931-1965 <sup>2</sup>	133	73	346	56	608
1966	4	0	20	1	25
1967	5	0	16	3	24
1968	4	1	26	4	35
1969	2	0	18	1	21
1970	3	0	23	3	29
1971	2	0	15	3	20
1972	3	1	16	2	22
1973	2	0	7	0	9
1974	0	0	10	1	11
1975	1	0	13	1	15
1976	3	0	12	0	15
1977	1	0	7	1	9
1978	0	0	9	0	9
1979	0	0	3	1	4
1980	0	0	9	0	9
1981	2	0	5	2	9
1982	2	0	7	1	10
1983	0	0	4	0	4
1984	1	0	4	1	6
1985	2	0	4	1	7
1986	1	0	11	1	13
1987	0	0	4	0	4
1988	0	0	7	0	7
1989	0	0	4	0	4
1990	0	0	0	0	0
1991	0	0	3	0	3
1992	0	0	2	0	2
1993	0	0	3	1	4
1994	0	0	0	1	1
1995	0	0	4	0	4
1996	0	0	5	0	5

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<b>Year</b>	<b>Organized youth Direct</b>	<b>Pro &amp; Semi-pro Direct</b>	<b>Middle &amp; High School Direct</b>	<b>College Direct</b>	<b>Total Direct</b>
1997	0	0	6	1	7
1998	0	0	6	1	7
1999	1	0	4	1	6
2000	0	0	3	0	3
2001	1	0	8	0	9
2002	1	1	3	1	6
2003	1	0	2	0	3
2004	1	0	4	0	5
2005	0	1	2	0	3
2006	0	0	1	0	1
2007	0	1	3	0	4
2008	0	0	7	0	7
2009	1	0	2	0	3
2010	1	0	2	2	5
2011	1	0	3	1	5
2012	0	2	1	0	3
2013	0	0	8	0	8
2014	0	0	5	1	6
2015	0	0	7	0	7
2016	0	1	2	0	3
2017	0	0	2	2	4
2018	0	0	2	0	2
2019	0	0	4	0	4
2020 <sup>3</sup>	0	0	0	0	0
2021 <sup>3</sup>	0	0	4	0	4
2022	0	0	3	0	3
2023	1	0	2	0	3
2024	0	0	3	1	4
2025	0	0	0	0	0
<b>Total:</b>	<b>180</b>	<b>81</b>	<b>716</b>	<b>96</b>	<b>1,073</b>
<b>Percent:</b>	<b>16.8%</b>	<b>7.5%</b>	<b>66.7%</b>	<b>8.9%</b>	<b>100.00%</b>

<sup>1</sup>No study was made in 1942.

<sup>2</sup>Yearly totals available from past reports.

<sup>3</sup>Some teams played their Fall 2020 competitive season in Spring 2021. This in addition to a Fall 2021 competitive season suggests that some teams played two competitive seasons in calendar year 2021.

<sup>4</sup>Fatalities with an unknown cause will not appear in this table.

**TABLE II. EXERTIONAL/MEDICAL (INDIRECT) FATALITIES INDIRECTLY DUE TO FOOTBALL - 1931-2025<sup>1,4</sup>**

<b>Year</b>	<b>Organized youth Indirect</b>	<b>Pro &amp; Semi-pro Indirect</b>	<b>Middle &amp; High School Indirect</b>	<b>College Indirect</b>	<b>Total Indirect</b>
1931-1965 <sup>2</sup>	88	14	164	40	306
1966	0	0	5	2	7
1967	0	0	4	1	5
1968	2	0	8	2	12
1969	4	2	8	3	17
1970	0	0	12	2	14
1971	2	2	7	2	13
1972	0	0	11	1	12
1973	0	0	5	3	8
1974	0	0	5	3	8
1975	2	0	3	3	8
1976	1	0	10	2	13
1977	0	0	7	0	7
1978	0	0	8	1	9
1979	1	1	8	1	11
1980	0	0	4	0	4
1981	0	0	6	0	6
1982	1	0	7	3	11
1983	0	0	6	3	9
1984	0	0	3	0	3
1985	0	0	1	1	2
1986	0	0	6	1	7
1987	1	0	4	3	8
1988	0	0	10	0	10
1989	0	0	9	2	11
1990	0	0	3	3	6
1991	0	0	3	1	4
1992	1	0	9	1	11
1993	0	0	8	1	9
1994	1	0	2	2	5
1995	0	0	8	1	9
1996	0	1	10	1	12

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<b>Year</b>	<b>Organized youth Indirect</b>	<b>Pro &amp; Semi-pro Indirect</b>	<b>Middle &amp; High School Indirect</b>	<b>College Indirect</b>	<b>Total Indirect</b>
1997	1	0	7	0	8
1998	1	0	6	1	8
1999	1	0	12	0	13
2000	0	0	11	2	13
2001	0	2	10	3	15
2002	1	0	9	3	13
2003	1	1	4	1	7
2004	1	0	7	3	11
2005	1	1	8	2	12
2006	2	0	12	2	16
2007	1	1	6	1	9
2008	3	0	7	3	13
2009	2	0	14	2	18
2010	1	0	9	2	12
2011	0	0	11	1	12
2012	0	0	7	4	11
2013	0	0	8	0	8
2014	1	0	5	3	9
2015	2	0	6	1	9
2016	2	0	5	2	9
2017	0	0	6	2	8
2018	0	0	4	5	9
2019	1	0	9	2	12
2020 <sup>3</sup>	0	0	7	0	7
2021 <sup>3</sup>	0	0	11	2	13
2022	2	0	4	0	5
2023	1	0	4	3	8
2024	1	0	7	1	9
2025	1	0	5	0	6
<b>Total:</b>	<b>130</b>	<b>25</b>	<b>585</b>	<b>140</b>	<b>880</b>
<b>Percent:</b>	<b>14.8%</b>	<b>2.8%</b>	<b>66.5%</b>	<b>15.9%</b>	<b>100.00%</b>

<sup>1</sup>No study was made in 1942.

<sup>2</sup>Yearly totals available from past reports.

<sup>3</sup>Some teams played their Fall 2020 competitive season in Spring 2021. This in addition to a Fall 2021 competitive season suggests that some teams played two competitive seasons in calendar year 2021.

<sup>4</sup>Fatalities with an unknown cause will not appear in this table.

**TABLE III. TRAUMATIC INJURY (DIRECT) & EXERTIONAL/MEDICAL (INDIRECT) FATALITIES INCIDENCE PER 100,000 # PARTICIPANTS – 1968-2025<sup>1, 2</sup>**

Year	<u>Direct</u>		<u>Indirect</u>	
	Middle & High School <sup>3</sup>	College <sup>4</sup>	Middle & High School <sup>3</sup>	College <sup>4</sup>
1968	2.6	5.33	0.8	2.67
1969	1.8	1.33	0.8	4
1970	2.3	4	1.2	2.67
1971	1.5	4	0.7	2.67
1972	1.6	2.67	1.1	1.33
1973	0.7	0	0.5	4
1974	1	1.33	0.5	4
1975	1.3	1.33	0.3	4
1976	1.2	0	1	2.67
1977	0.7	1.33	0.7	0
1978	0.9	0	0.8	1.33
1979	0.3	1.33	0.8	1.33
1980	0.9	0	0.4	0
1981	0.5	2.67	0.6	0
1982	0.7	1.33	0.7	4
1983	0.4	0	0.6	4
1984	0.4	1.33	0.3	0
1985	0.31	1.33	0.08	1.33
1986	0.85	1.33	0.46	1.33
1987	0.31	0	0.31	4
1988	0.54	0	0.77	0
1989	0.31	0	0.69	2.67
1990	0	0	0.23	4
1991	0.23	0	0.23	1.33
1992	0.15	0	0.69	1.33
1993	0.23	1.33	0.62	1.33
1994	0	1.33	0.15	2.67
1995	0.31	0	0.62	1.33
1996	0.38	0	0.77	1.33
1997	0.46	1.33	0.54	0
1998	0.46	1.33	0.46	1.33
1999	0.31	1.33	0.92	0
2000	0.23	0	0.85	2.67
2001	0.62	0	0.77	4
2002	0.23	1.33	0.69	4
2003	0.15	0	0.31	1.33
2004	0.31	0	0.54	4

Year	<u>Direct</u>		<u>Indirect</u>	
	Middle & High School <sup>3</sup>	College <sup>4</sup>	Middle & High School <sup>3</sup>	College <sup>4</sup>
2005	0.15	0	0.62	2.67
2006	0.08	0	0.92	2.67
2007	0.23	0	0.46	1.33
2008	0.54	0	0.54	4
2009	0.15	0	1.08	2.67
2010	0.15	2.67	0.69	2.67
2011	0.2	1.33	0.73	1.33
2012	0.09	0	0.64	5.33
2013	0.73	0	0.73	0
2014	0.45	1.33	0.45	4
2015	0.64	0	0.55	1.33
2016	0.18	0	0.45	2.67
2017	0.18	2.67	0.55	2.67
2018	0.18	0	0.36	6.67
2019	0.36	0	0.82	2.67
2020 <sup>5</sup>	0	0	0.64	0
2021 <sup>5</sup>	0.36	0	1	2.67
2022	0.27	0	0.36	0
2023	0.18	0	0.36	4
2024	0.27	1.33	0.64	1.33
2025	0	0	0.45	0

<sup>1</sup>No study was made in 1942.

<sup>2</sup>Yearly totals available from past reports.

<sup>3</sup>Rates based on 1, 1.3, 1.5 and 1.1 million participants in 1968-1984, 1985-2010, 2011 and 2012-2020, respectively, for players grades 9-12.

<sup>4</sup>Rates based on 75,000 in all years for college players.

<sup>5</sup>Some teams played their Fall 2020 competitive season in Spring 2021. This in addition to a Fall 2021 competitive season suggests that some teams played two competitive seasons in calendar year 2021. Incidence rates do not account for this.

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

**TABLE IV. HEAT STROKE FATALITIES – 1931-2025<sup>1</sup>**

<b>Year</b>	<b>Total</b>
1931-1965 <sup>2</sup>	26
1966	1
1967	2
1968	5
1969	5
1970	8
1971	4
1972	7
1973	3
1974	1
1975	0
1976	1
1977	1
1978	4
1979	2
1980	1
1981	2
1982	2
1983	1
1984	3
1985	0
1986	0
1987	1
1988	2
1989	2
1990	1
1991	0
1992	1
1993	0
1994	0
1995	5
1996	2
1997	1
1998	4
1999	2

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<b>Year</b>	<b>Total</b>
2000	3
2001	3
2002	0
2003	0
2004	3
2005	3
2006	5
2007	2
2008	6
2009	4
2010 <sup>2</sup>	5
2011	5
2012	1
2013	0
2014	2
2015	2
2016	2
2017	3
2018	2
2019	1
2020 <sup>3</sup>	4
2021 <sup>3</sup>	3
2022	1
2023	1
2024	1
2025 <sup>2</sup>	2
<b>Total since 1996</b>	<b>73</b>
<b>Total, 1931-2025</b>	<b>164</b>

<sup>1</sup>No study was made in 1942.

<sup>2</sup>Three fatalities (2 in 2010 and 1 on 2025) were a combination of heat and sickle cell trait.

<sup>3</sup>Some teams played their Fall 2020 competitive season in Spring 2021. This in addition to a Fall 2021 competitive season suggests that some teams played two competitive seasons in calendar year 2021.

**TABLE V. CHARACTERISTICS OF TRAUMATIC INJURY (DIRECT) FATALITIES**

**2025**

Characteristics	Organized youth		Pro & Semi-Pro		Middle & High school		College		All	
	N	%	N	%	N	%	N	%	N	%
Month										
Type of Activity										
Type of Session										
Position	<i>There were no fatal direct traumatic injuries in 2025.</i>									
Location of Injury										
Type of Injury										
Suspected Cause										
<b>Total</b>										<b>0</b>

<sup>1</sup>Fatalities with an unknown cause will not appear in this table.

**TABLE VI. CHARACTERISTICS OF EXERTIONAL/MEDICAL (INDIRECT)  
FATALITIES 2025**

Characteristics	Organized youth		Pro & Semi-Pro		Middle & High school		College		All	
	N	%	N	%	N	%	N	%	N	%
<b>Month</b>										
Jan-Feb	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Jul-Aug	0	0.0%	0	0.0%	3	60.0%	0	0.0%	3	50.0%
Sep-Oct	1	100.0%	0	0.0%	1	20.0%	0	0.0%	2	33.3%
<b>Type of Activity</b>										
Conditioning (land)	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Other	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Unknown	1	100.0%	0	0.0%	2	40.0%	0	0.0%	3	50.0%
Weights	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
<b>Type of Session</b>										
Competition/Game	1	100.0%	0	0.0%	1	20.0%	0	0.0%	2	33.3%
Conditioning Session	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Practice	0	0.0%	0	0.0%	2	40.0%	0	0.0%	2	33.3%
Strength/Weight Session	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
<b>Position</b>										
Offensive Lineman	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Other	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Unknown	1	100.0%	0	0.0%	3	60.0%	0	0.0%	4	66.7%
<b>Location of Injury</b>										
Competitive Venue	0	0.0%	0	0.0%	3	60.0%	0	0.0%	3	50.0%
Other	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1	16.7%
School Athletic Facility	0	0.0%	0	0.0%	2	40.0%	0	0.0%	2	33.3%
<b>Type of Injury</b>										
Cardiac/Sudden Cardiac Arrest	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1	16.7%
Complications Of Sickle Cell Trait	0	0.0%	0	0.0%	2	40.0%	0	0.0%	2	33.3%
Heat-Related Injury	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Other	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Pulmonary Embolism	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%

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Characteristics	Organized youth		Pro & Semi-Pro		Middle & High school		College		All	
	N	%	N	%	N	%	N	%	N	%
<b>Suspected Cause</b>										
Arteriovenous Malformation	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Cardiac/Sudden Cardiac Arrest	1	100.0%	0	0.0%	0	0.0%	0	100.0%	1	16.7%
Heat Stroke	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Pulmonary Embolism	0	0.0%	0	0.0%	1	20.0%	0	0.0%	1	16.7%
Sickle Cell Trait	0	0.0%	0	0.0%	2	40.0%	0	0.0%	2	33.3%
<b>Total</b>	<b>1</b>	<b>100.0%</b>	<b>0</b>	<b>0.0%</b>	<b>5</b>	<b>100.0%</b>	<b>1</b>	<b>100.0%</b>	<b>7</b>	<b>100.0%</b>

<sup>1</sup>Fatalities with an unknown cause will not appear in this table.

**TABLE VII. CHARACTERISTICS OF NON-FOOTBALL AND NON-EXERTION RELATED FATALITIES 2025**

Characteristics	Organized youth		Pro & Semi-Pro		Middle & High school		College		All	
	N	%	N	%	N	%	N	%	N	%
<b>Month</b>										
Jan-Feb	0	0.0%	0	0.0%	0	0.0%	1	33.3%	1	25.0%
Mar-Apr	0	0.0%	0	0.0%	0	0.0%	1	33.3%	1	25.0%
Jul-Aug	0	0.0%	0	0.0%	1	100.0%	0	0.0%	1	25.0%
Nov-Dec	0	0.0%	0	0.0%	0	0.0%	1	33.3%	1	25.0%
<b>Type of Activity</b>										
Other	0	0.0%	0	0.0%	0	0.0%	2	100.0%	2	50.0%
Unknown	0	0.0%	0	0.0%	1	100.0%	1	0.0%	2	50.0%
<b>Type of Session</b>										
Non-athletic activity	0	0.0%	0	0.0%	1	100.0%	2	66.7%	3	75.0%
Unaffiliated Recreational Activity	0	0.0%	0	0.0%	0	0.0%	1	33.3%	1	25.0%
<b>Position</b>										
Offensive Lineman	0	0.0%	0	0.0%	0	0.0%	2	66.7%	2	50.0%
Unknown	0	0.0%	0	0.0%	1	100.0%	1	33.3%	2	50.0%
<b>Location of Injury</b>										
Athlete's Home	0	0.0%	0	0.0%	1	100.0%	2	66.7%	3	100.0%
Competitive Venue	0	0.0%	0	0.0%	0	0.0%	1	33.3%	1	100.0%
<b>Type of Injury</b>										
Cardiac/Sudden Cardiac Arrest	0	0.0%	0	0.0%	1	100.0%	3	100.0%	4	100.0%
<b>Suspected Cause</b>										
Cardiac/Sudden Cardiac Arrest	0	0.0%	0	0.0%	1	100.0%	3	100.0%	4	100.0%
<b>Total</b>	<b>0</b>	<b>0.0%</b>	<b>0</b>	<b>0.0%</b>	<b>1</b>	<b>100.0%</b>	<b>3</b>	<b>100.0%</b>	<b>4</b>	<b>100.0%</b>

*Note: Beginning in 2014, NCCSIR is collecting information on suspected cardiac-related deaths in football players but that did not occur during football-related activities (e.g. playing recreational basketball) or exertion (e.g. died in sleep). Understanding the etiology and timing of sudden cardiac arrest/death in athletes requires studying events that occurred while the athlete was not physically exerting themselves or during sleep.*

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**TABLE VIII: HEAD AND CERVICAL SPINE FATALITIES BY DECADE, 1946-2025**

<b>Year</b>	<b>Cervical Spine</b>		<b>Head/brain</b>	
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
1946-1955	32	25.6%	91	15.9%
1956-1965	30	24.0%	128	22.3%
1966-1975	37	29.6%	155	27.0%
1976-1985	13	10.4%	65	11.3%
1986-1995	4	3.2%	34	5.9%
1996-2005	2	1.6%	43	7.5%
2006-2015	6	4.8%	34	5.9%
2016-2025	1	0.8%	24	4.2%
<b>Totals</b>	<b>125</b>	<b>100.0%</b>	<b>576</b>	<b>100.0%</b>

**TABLE IX: TRAUMATIC INJURY (DIRECT) AND EXERTIONAL/MEDICAL (INDIRECT) FATALITIES BY 5-YEAR PERIOD, 1976-2025**

<b>Year</b>	<b>Traumatic Injury (Direct)</b>		<b>Exertional/Medical (Indirect)</b>	
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
1976-1980	48	18.7%	44	9.3%
1981-1985	37	14.4%	32	6.8%
1986-1990	28	10.9%	43	9.1%
1991-1995	14	5.4%	38	8.1%
1996-2000	28	10.9%	54	11.4%
2001-2005	26	10.1%	58	12.3%
2006-2010	20	7.8%	68	14.4%
2011-2015	29	11.3%	49	10.4%
2016-2020	13	5.1%	45	9.5%
2021-2025	14	5.4%	41	8.7%
<b>Totals</b>	<b>257</b>	<b>100.0%</b>	<b>472</b>	<b>100.0%</b>

FIGURE I: HEAD AND CERVICAL SPINE FATALITIES BY 10-YEAR PERIOD, 1946-2025

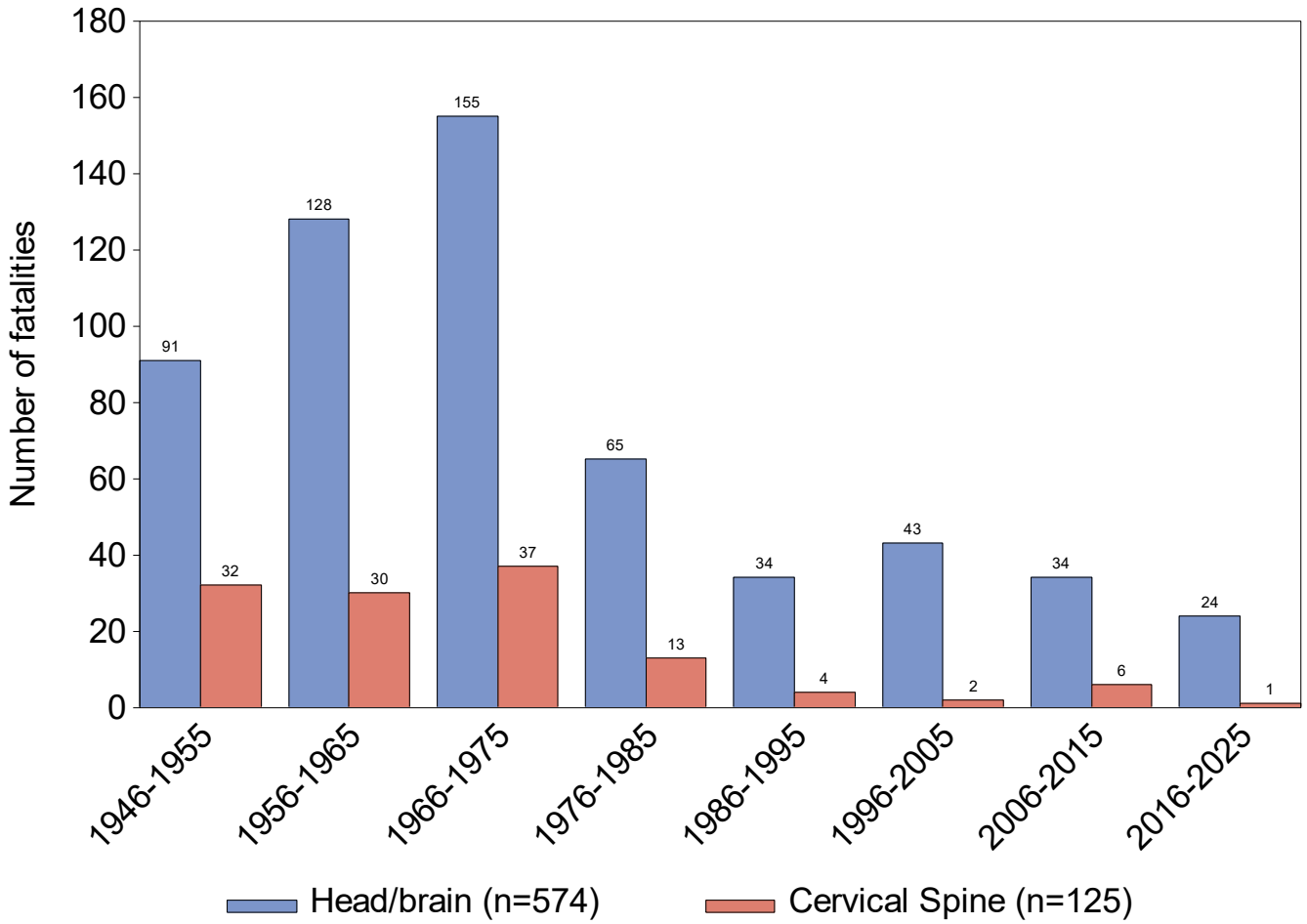


FIGURE II: DIRECT AND INDIRECT FATALITIES BY 5-YEAR PERIOD, 1976-2025

