

ANNUAL SURVEY OF FOOTBALL INJURY RESEARCH

1931 - 2015

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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., Purdue University succeeded Dr. Stevens in 1942 and served through 1964. Carl S. Blyth, Ph.D., 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., 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 a 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, 1931, that there was not a direct fatality in football at any level of play.(Mueller & Schindler 1991) This clearly 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 Injury Research (NCCSIR) was established in 1982. The NCCSIR has been directed for the past 30 years by Dr. Frederick Mueller. Dr. Mueller retired Spring of 2013 and the NCCSIR Annual Football Survey 2015

continues under new direction (Dr. 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:

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

Indirect (exertional/systemic) – 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-exertion related – Beginning in 2014, NCCSIR is collecting information on suspected cardiac-related deaths that did not occur during exertion (e.g. died in sleep). These events are reported as “Non-exertion related fatalities”.

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. NCCSIR and the Consortium for Catastrophic Injury Monitoring in Sport have developed an online portal where anyone can report a catastrophic event (www.sportinjuryreport.org). 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 www.sportinjuryreport.org. Autopsy reports are used when 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: NFHS has estimated that there are approximately 1,100,000 high school player's 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 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 and Dr. David Klossner, PhD, ATC 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 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, colleagues, coaches, and athletic trainers. 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

Direct Fatalities

There were seven fatalities directly related to football during the 2015 football season: all fatalities were in high school football (all in the fall) (Table I). There were no direct fatalities reported in organized youth, college, professional, or semi-professional levels.

For the approximately 4,200,000 participants in 2014, the rate of direct fatalities was 0.17 per 100,000 participants (95% confidence interval: 0.04 to 0.29). The rate of direct fatalities in 2014 for high school (grades 9-12) was 0.64 per 100,000 participants (95% CI: 0.16 to 1.11) (Table III).

All of direct fatalities in 2015 occurred during competition; all but one occurred in regularly scheduled games. The football activities attributed to the direct fatalities were tackling or being tackled (71.5%), being blocked (14.3%), and unknown activities (14.3%) (Table V). Of direct fatalities, 71.5% were brain/head injuries, 14.3% were cervical fracture, and 14.3% were internal organ (Table V).

Indirect Fatalities

In 2015 there were ten indirect fatalities that occurred among football players during football-related activities or physical exertion (Table II). Seven fatalities (70%) were associated with high school football (2 heat stroke, 2 cardiac-related, 1 exertional sickling, and 2 unknown), 1 at the college/university level (cardiac-related), and two at the organized youth level (cardiac-related) (Table VI). Three occurred during football practice, six were during conditioning, and one was from other activities.

Non-exertional Related Fatalities

There were three fatalities that occurred outside of exertional activity (all athletes died at home) (Table VII). The cause of these was suspected to be cardiac-related.

DISCUSSION

Fatalities in the sport of football are rare but tragic events. A total of seventeen direct and indirect fatalities were recorded for the 2015 football season out of twenty fatalities collected by NCCSIR. Even though the rate of direct fatal injuries was very low on a 100,000 participant basis, all occurred 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 2015 report continues the 10-year trend of direct fatal events at an overall rate of 0.17 per 100,000 football participants (FIGURE II). Roughly 80% of brain football-related fatalities from 1990 to 2010 occurred during competition (Boden et al. 2013) and the current year's results continue this trend. There was one fatal traumatic internal organ injury in high school football. Fatal traumatic internal organ injuries are rare; from 1990-2010 NCCSIR recorded three fatal traumatic internal organ injuries in high school football (Boden et al. 2013).

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. Indirect injuries have been in double figures since 1999 with the exception of 2003 and 2007. Since the 1990, indirect fatalities have outnumbered direct fatalities on average 2 to 1 (FIGURE II). An important observation is that the college football level has recorded only one fatality 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. Cardiac events were the primary cause of indirect deaths due to exertion in 2015 which is consistent with published research (Harmon et al. 2011). There were also two reported deaths due to heat stroke emphasizing the need for continued safety efforts surrounding practicing in hot weather.

Beginning in 2014, NCCSIR is collecting information on 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 three fatalities in 2015.

Head and Neck Injuries

The past 10 years (2006-2015) have recorded low numbers of head and neck fatalities (35) compared to when data collection began in 1931 (Table VIII and Figure I). This is encouraging and supports the success of past efforts to reduce fatalities in football. Before a 1976 rule change that eliminated the head as the initial contact point in blocking and tackling, fatalities in football averaged more than 10 a year (Table VIII). 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 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,

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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). **Coaches who are teaching helmet or face to the numbers tackling and blocking are not only breaking the football rules, but are placing their players at risk for permanent paralysis or death. 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 have been caused by brain and neck injuries, and in fact since 1990 all but seven of the head and neck deaths have been brain injuries (72). 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. It is imperative that helmets be purchased, fitted, and properly reconditioned by manufacturer standards. A good rule of thumb is to budget for rotating out a specified number of helmets each year. In addition, helmets 10 years or older will not be reconditioned or returned to the team. 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 are convinced 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.

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 tacking and running with the ball. Contact should never with the top 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, film 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.

5. **Brain Injury and Concussion:** A brain injury, including concussions, can be caused by a bump, blow, or jolt 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 the following CDC resource for a list of states with concussion policies:

GET A HEADS UP ON CONCUSSION IN SPORTS POLICIES:

Information for Parents, Coaches, and School & Sports Professionals.

Available at: <http://www.cdc.gov/headsup/policy/index.html>

For the most up to date information on concussion management please refer to the updated Consensus Statement on Concussion in Sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012 (McCrory et al. 2013).

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, (1982-2014). Available at:

<http://www.nfhs.org/media/1015670/1982-2015-nfhs-risk-minimization-rules.pdf>

NCAA changes to minimize risk of injury (2009). Available at:

<http://fs.ncaa.org/Docs/NCAANewsArchive/2009/Association-wide/ncaa+changes+to+minimize+risk+of+injury+-+12-10-09+-+ncaa+news.html>

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, (2013). Available at:

<http://static.nfl.com/static/content/public/photo/2015/11/12/0ap3000000578872.pdf>

Heat Stroke

A continuous effort should be made to eliminate heat stroke deaths associated with football. Since the beginning of the survey through 1959 there were five cases of heat stroke death reported. However, these events were not routinely monitored during this period. From 1960 through 2015 there have been 141 heat stroke cases that resulted in death (Table IV). Authors believe that heat stroke deaths are preventable with the proper precautions and emergency management. Since 1995, 59 football players have died from heat stroke (45 high school, 11 college, 2 professional, and one organized youth). Ninety percent of recorded heat stroke deaths occurred during practice. During the most recent five year period from 2011-2015 there was an average of 2.2 heat stroke deaths per year compared to 4.4 per year during the

previous five year period 2006-2010. This decline is encouraging and supports continued efforts to educate coaches, school administrators, medical providers, players, and parents concerning the proper procedures and precautions when practicing or playing in the heat. It is important to note that in addition to the two heat stroke deaths this year, last year there were also two heat stroke deaths and two deaths that were a result of athletes *over-hydrating* in order to prevent heat-related issues. Prevention messages must go beyond hydrating but emphasize how to properly hydrate.

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 (<http://natajournals.org/doi/pdf/10.4085/1062-6050-44.3.332>) (Casa & Cisslan, 2009) 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 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.
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. Use of a sling psychrometer is recommended to measure the relative 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. 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 frequently throughout a practice session. Athletes should drink water before, during, and after practice. Sports drinks that contain sodium (salt) and potassium can be consumed to replace electrolytes lost during activity.
7. **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.
8. **Clothing & Equipment:** Clothing is important and a player should wear moisture wicking apparel to dissipate heat. Never use rubberized clothing or sweatsuits.
9. **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.

10. **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>). NCAA and the NFHS have guidelines for these plans at the following websites:

<http://www.nfhs.org/media/1015653/heat-acclimatization-and-heat-illness-prevention-position-statement-2015.pdf> and www.ncaa.org.

11. **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. 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, and 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.

RECOMMENDATIONS

Specific recommendations resulting from the 2015 survey data are as follows:

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.
3. Emergency measures must be in place for all games and practice sessions. Whenever possible certified athletic trainers should be present for all football practices and games. Physicians should be onsite or accessible for all practices and onsite for all games.
4. All personnel associated with football participation should be cognizant of the safety measures related to physical activity in hot weather.
5. Each institution should strive to have a certified athletic trainer.
6. All individuals, groups and organizations interested in sport safety should continue their efforts and collaborations to ensure the safety of football for all participants.
7. 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.

8. There should be a renewed emphasis on employing well-trained athletic personnel, providing excellent facilities, and securing the safest and best equipment possible.
9. There should be continued research concerning the safety of football players in practice and games (rules, facilities, equipment, etc.).
10. 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.
11. Strict enforcement of the rules of the game by both coaches and game officials will help reduce serious injuries. Be aware of the 2005 rule change to the 1976 definition of spearing and to the 2007 high school rules concerning illegal helmet contact (see page 11 of report).
12. 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.
13. The number of indirect heart related deaths has increased over the years and it is recommended that schools have an emergency action plan and automated external defibrillators (AED) available for emergency situations.
14. A more recent concern for indirect deaths in football players is sickle cell trait. Research has mentioned that up to 13 college football players have died after an on field collapse due to complication of 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. The NATA supports this concept with their statement–

Consensus Statement: Sickle Cell Trait and the Athlete available at:

(<http://www.nata.org/sites/default/files/SickleCellTraitAndTheAthlete.pdf>). (Inter-

Association Task Force on Sickle Cell Trait and the Athlete, 2007) The statement

includes precautions for athletes with sickle cell trait.

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CASE SUMMARIES CALENDAR YEAR 2015

All summaries compiled from publicly available media sources.

DIRECT FATALITIES

HIGH SCHOOL

A male 16 year old freshman high school football player was hit by another player during the 4th quarter punt return. Another teammate reported that he tripped and fell into a blocker which caused his head to go backwards. He was immediately attended to by EMS and athletic trainers. He was transported to the hospital but later died. Cause of death is due to a broken neck.

A male 17 year old high school senior football quarterback sustained a hit in the 2nd quarter of a game. He walked off the field but appeared disoriented. Around halftime he collapsed on the sidelines. He was transported to the hospital but later died. Cause of death was due to a ruptured spleen.

A male 16 year old high school junior football linebacker scored a touchdown during the 4th quarter of a game. He sustained a head injury during a tackle on the kickoff return. He was transported to the hospital where he underwent surgery. He was placed in a medical coma but died a week later. Cause of death is pending autopsy.

A male 17 year old high school senior football defensive back was injured while making a tackle during the 4th quarter of a game. He was transported by ambulance to the hospital where he underwent emergency brain surgery. He died three days later. Cause of death was due to blunt force trauma. Reports indicate that he has sustained a concussion about a month prior but was cleared for return to play.

A male high school junior football wide receiver, quarterback, and safety complained of dizziness before halftime of a game. He then collapsed. He was airlifted to the hospital where he later died. Official cause of death was due to subdural hematoma.

A male 17 year old high school senior football player was injured on a kick return play during a playoff game. He was running, was blocked by an opponent, laid on the field, got up, complained of a headache, and collapsed on the sideline. He was attended to by EMS before being transported to the hospital. He died the following morning. Cause of death was due to a blunt force head injury.

A male 17 year old high school football player had just scored a touchdown during a playoff game, walked off the field, and collapsed. He was transported by ambulance to the hospital before being airlifted to another. He was diagnosed with head trauma that cause his brain to swell. He died the following day.

ORGANIZED YOUTH (SANDLOT)

NONE IN 2015

COLLEGE

NONE IN 2015

PROFESSIONAL

NONE IN 2015

INDIRECT FATALITIES

HIGH SCHOOL

A male 15 year old high school freshman football player was jumping rope during the conditioning session of a spring practice when he collapsed. EMS administered CPR before being transported to the hospital where he later died. Cause of death is suspected to be due to sudden cardiac arrest.

A male 13 year old high school freshman football player was stretching prior to a weight training session when he collapsed. He was attended to by coaches until EMS arrived. Cause of death is pending but is suspected to be related to heart disease.

A male 16 year old high school junior football player was at a morning football practice when he began having difficulty breathing. He was transported to the field house and an ambulance was called. He later died at the hospital. Cause of death is due to hyperthermia (heat stroke) and rhabdomyolysis. Reports indicate that heat index had reached 109° by 11am.

A male 14 year old high school sophomore football offensive lineman collapsed during football practice. He was transported to the hospital where he later died due to complications from heat stroke. His body temperature was reported to have reached 105 degrees.

A male 16 year old high school junior football defensive end felt ill during a strength and conditioning workout. EMS were called, but nothing was found wrong. He later fell ill again at home and was taken to the hospital, where he was found to be extremely dehydrated. His condition deteriorated rapidly and he died later. Cause of death was due to exertional sickling due to prolonged physical activity complicating sickle cell trait.

A male 17 year old high school junior offensive lineman collapsed during practice. He was immediately attended to by the athletic trainer who began CPR. He was transported by EMS to the hospital where he died two weeks later. Cause of death is due to pulmonary edema from hypertensive heart disease.

A male 13 year old middle school 8th grade football player collapsed after running during gym class. CPR was administered while EMS were called. He was transported to the hospital where he later died. Cause of death was due to hypertrophic cardiomyopathy.

ORGANIZED YOUTH (SANDLOT)

A male 10 year old youth league football player was participating in his first football practice. He was running with other teammates when he suddenly stopped and collapsed. He later died at the hospital. Cause of death was due to a congenital heart defect--anomalous origin of the left coronary artery.

A male 9 year old youth league football player collapsed during a break at practice. CPR was immediately started while an ambulance was called. He died shortly after. Cause of death was due to a congenital heart defect.

COLLEGE

A male 25 year old collegiate football offensive lineman collapsed during training after complaining of shortness of breath and chest pain. He had complained of chest pains the previous day but preliminary assessment by training staff did not find anything abnormal. EMS arrived and CPR was started before he was transported to the hospital. He died shortly after due to cardiac arrest.

PROFESSIONAL

NONE IN 2015

NON EXERTION-RELATED FATALITIES

HIGH SCHOOL

A male high school senior football player died at his home from sudden cardiac arrest.

COLLEGE

A male 19 year old college freshman football player complained of feeling ill. He went to the ER, was sent home with medication, and was found dead by his roommates found him the next morning. Cause of death is suspected to be from complications of seizures.

A male 21 year old college football player was found unresponsive in his dorm room. CPR was administered until EMS arrived. He was taken to the hospital where he died shortly after. Cause of death is suspected to be cardiac related.

TABLE I: FATALITIES DIRECTLY DUE TO FOOTBALL – 1931-2015¹

	Organized Youth Direct	Pro & Semi-pro Direct	Middle & High School Direct	College Direct	Total Direct
1931-1965 ²	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	0	9
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

TABLE I (CONTINUED): FATALITIES DIRECTLY DUE TO FOOTBALL – 1931-2015¹

	Organized Youth Direct	Pro & Semi-pro Direct	Middle & High School Direct	College Direct	Total Direct
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
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	4	1	6
2012	0	2	1	0	3
2013	0	0	8	0	8
2014	0	0	5	1	6
2015	0	0	7	0	7
TOTAL:	179	80	695	92	1046
Percent	17.1%	7.6%	66.4%	8.8%	100.0%

¹No study was made in 1942.

²Yearly totals available from past reports.

TABLE II: FATALITIES INDIRECTLY DUE TO FOOTBALL – 1931-2015¹

	Organized Youth Indirect	Pro & Semi-pro Indirect	Middle & High School Indirect	College Indirect	Total Indirect
1931-1965 ²	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	10	1	11
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

TABLE II (CONTINUED): FATALITIES INDIRECTLY DUE TO FOOTBALL – 1931-2015¹

	Organized Youth Indirect	Pro & Semi-pro Indirect	Middle & High School Indirect	College Indirect	Total Indirect
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
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	8	3	12
2003	1	1	4	1	7
2004	0	0	7	3	10
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	0	0	9	2	11
2011	0	0	11	1	12
2012	0	0	6	4	10
2013	0	0	7	0	7
2014	1	0	7	3	11
2015	2	0	7	1	10
TOTAL:	121	25	522	123	791
Percent	15.3%	3.2%	66.0%	15.5%	100.0%

¹No study was made in 1942.

²Yearly totals available from past reports.

TABLE III: DIRECT FATALITIES INCIDENCE PER 100,000 PARTICIPANTS – 1968-2015^{1,2}

Year	Middle and high school³	College³
1968	2.60	5.33
1969	1.80	1.33
1970	2.30	4.00
1971	1.50	4.00
1972	1.60	2.67
1973	0.70	0.00
1974	1.00	1.33
1975	1.30	1.33
1976	1.20	0.00
1977	0.70	1.33
1978	0.90	0.00
1979	0.30	1.33
1980	0.90	0.00
1981	0.50	2.67
1982	0.70	0.00
1983	0.40	0.00
1984	0.40	1.33
1985	0.31	1.33
1986	0.85	1.33
1987	0.31	0.00
1988	0.54	0.00
1989	0.31	0.00
1990	0.00	0.00
1991	0.23	0.00
1992	0.15	0.00
1993	0.23	1.33

TABLE III (CONTINUED): DIRECT FATALITIES INCIDENCE PER 100,000 PARTICIPANTS – 1968-2015^{1,2}

Year	Middle and high school³	College³
1994	0.00	1.33
1995	0.31	0.00
1996	0.38	0.00
1997	0.46	1.33
1998	0.46	1.33
1999	0.31	1.33
2000	0.23	0.00
2001	0.62	0.00
2002	0.23	1.33
2003	0.15	0.00
2004	0.31	0.00
2005	0.15	0.00
2006	0.08	0.00
2007	0.23	0.00
2008	0.54	0.00
2009	0.15	0.00
2010	0.15	2.67
2011	0.27	1.33
2012	0.09	0.00
2013	0.64	0.00
2014	0.45	1.33
2015	0.64	0.00

¹No study was made in 1942.

²Yearly totals available from past reports.

³Rates based on 1,100,000 players grades 9-12, and 75,000 college players.

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

TABLE IV: HEAT STROKE FATALITIES – 1931-2015¹

Year	Total
1931-1954 ¹	0
1955	1
1956-1958	0
1959	4
1960-1964	16
1965	6
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

TABLE IV (CONTINUED): HEAT STROKE FATALITIES – 1931-2015¹

Year	Total
1999	2
2000	3
2001	3
2002	0
2003	0
2004	3
2005	3
2006	5
2007	2
2008	6
2009	4
2010	5
2011	6
2012	1
2013	0
2014	2
2015	2
Total since 1996:	54
TOTAL:	146

¹No study was made in 1942.

²In 2010 two were a combination of heat and sickle cell trait.

TABLE V: CHARACTERISTICS OF DIRECT FATALITIES 2015

	Organized Youth	Pro & Semipro	Middle & High School		College	All	
	N	N	N	%	N	N	%
Type of Activity							
Being blocked	0	0	1	14.3%	0	1	14.3%
Being tackled	0	0	3	42.9%	0	3	42.9%
General play	0	0	1	14.3%	0	1	14.3%
Tackling	0	0	2	28.6%	0	2	28.6%
Type of session							
Competition	0	0	7	100.0%	0	7	100.0%
Suspected cause							
Fracture	0	0	1	14.3%	0	1	14.3%
Hemorrhage	0	0	1	14.3%	0	1	14.3%
Subdural hematoma	0	0	1	14.3%	0	1	14.3%
Traumatic brain injury	0	0	3	42.9%	0	3	42.9%
Unknown	0	0	1	14.3%	0	1	14.3%
Position							
Defensive back	0	0	1	14.3%	0	1	14.3%
Linebacker	0	0	1	14.3%	0	1	14.3%
Punt returner	0	0	1	14.3%	0	1	14.3%
Quarterback	0	0	1	14.3%	0	1	14.3%
Running back	0	0	1	14.3%	0	1	14.3%
Unknown	0	0	2	28.6%	0	2	28.6%
Body part							
Head	0	0	2	28.6%	0	2	28.6%
Spleen	0	0	1	14.3%	0	1	14.3%
Brain	0	0	3	42.9%	0	3	42.9%
Neck or cervical vertebrae	0	0	1	14.3%	0	1	14.3%
Location of event							
School athletic facility	0	0	7	100.0%	0	7	100.0%
TOTAL:	0	0	7	100.0%	0	7	100.0%

TABLE VI: CHARACTERISTICS OF INDIRECT FATALITIES 2015

	Organized Youth		Pro & Semipro		College		Middle & High School		All	
	N	%	N	%	N	%	N	%	N	%
Type of Activity										
Conditioning (land)	0	0.0%	0	0.0%	0	0.0%	3	42.9%	3	30.0%
General play	0	0.0%	0	0.0%	0	0.0%	3	42.9%	3	30.0%
Running	1	50.0%	0	0.0%	0	0.0%	0	0.0%	1	10.0%
Not applicable	0	0.0%	0	0.0%	0	0.0%	1	14.3%	1	10.0%
Unknown	1	50.0%	0	0.0%	1	100.0%	0	0.0%	2	20.0%
Type of session										
Conditioning session	2	100.0%	0	0.0%	0	0.0%	4	57.1%	6	60.0%
Practice	0	0.0%	0	0.0%	1	100.0%	2	28.6%	3	30.0%
Other	0	0.0%	0	0.0%	0	0.0%	1	14.3%	1	10.0%
Suspected cause										
Heat stroke	0	0.0%	0	0.0%	0	0.0%	2	28.6%	2	20.0%
Sickle cell	0	0.0%	0	0.0%	0	0.0%	1	14.3%	1	10.0%
Cardiomyopathy	0	0.0%	0	0.0%	0	0.0%	1	14.3%	1	10.0%
Congenital heart	2	100.0%	0	0.0%	0	0.0%	0	0.0%	2	20.0%
Cardiac arrest	0	0.0%	0	0.0%	1	100.0%	1	14.3%	2	20.0%
Unknown	0	0.0%	0	0.0%	0	0.0%	2	28.6%	2	20.0%
Position										
Defensive end	0	0.0%	0	0.0%	0	0.0%	1	14.3%	1	10.0%
Offensive lineman	0	0.0%	0	0.0%	1	100.0%	2	28.6%	3	30.0%
Not applicable	0	0.0%	0	0.0%	0	0.0%	1	14.3%	1	10.0%
Unknown	2	100.0%	0	0.0%	0	0.0%	3	42.9%	5	50.0%
Body part										
Heart	2	100.0%	0	0.0%	1	100.0%	4	57.1%	7	70.0%
Red blood cells	0	0.0%	0	0.0%	0	0.0%	1	14.3%	1	10.0%
Total body	0	0.0%	0	0.0%	0	0.0%	2	28.6%	2	20.0%
Location of event										
School athletic facility	1	50.0%	0	0.0%	0	0.0%	0	0.0%	1	10.0%
School campus	1	50.0%	0	0.0%	0	0.0%	0	0.0%	1	10.0%
Other private property	0	0.0%	0	0.0%	1	100.0%	7	100.0%	8	80.0%
TOTAL:	2	100.0%	0	0.0%	1	100.0%	7	100.0%	10	100.0%

TABLE VII: CHARACTERISTICS OF NON-EXERTION RELATED FATALITIES 2015

	Organized Youth		Pro & Semipro		Middle & High School		College		All	
	N	%	N	%	N	%	N	%	N	%
Suspected cause										
Cardiac arrest	0	0.0%	0	0.0%	1	100.0%	2	100.0%	3	100.0%
Type of session										
NA	0	0.0%	0	0.0%	1	100.0%	2	100.0%	3	100.0%
Location of injury										
Home	0	0.0%	0	0.0%	1	100.0%	2	100.0%	2	100.0%
TOTAL:	0	0.0%	0	0.0%	1	100.0%	2	100.0%	3	100.0%

TABLE VIII: HEAD AND CERVICAL SPINE FATALITIES BY DECADE, 1946-2015

Year	Head		Cervical Spine	
	Frequency	Percent	Frequency	Percent
1946-1955	91	16.5%	32	25.8%
1956-1965	130	23.5%	28	22.6%
1966-1975	156	28.2%	37	29.8%
1976-1985	64	11.6%	14	11.3%
1986-1995	34	6.1%	5	4.0%
1996-2005	43	7.8%	2	1.6%
2006-2015	35	6.3%	6	4.8%
TOTAL:	553	100.0%	124	100.0%

FIGURE I: HEAD AND CERVICAL SPINE FATALITIES BY DECADE, 1946 to 2015

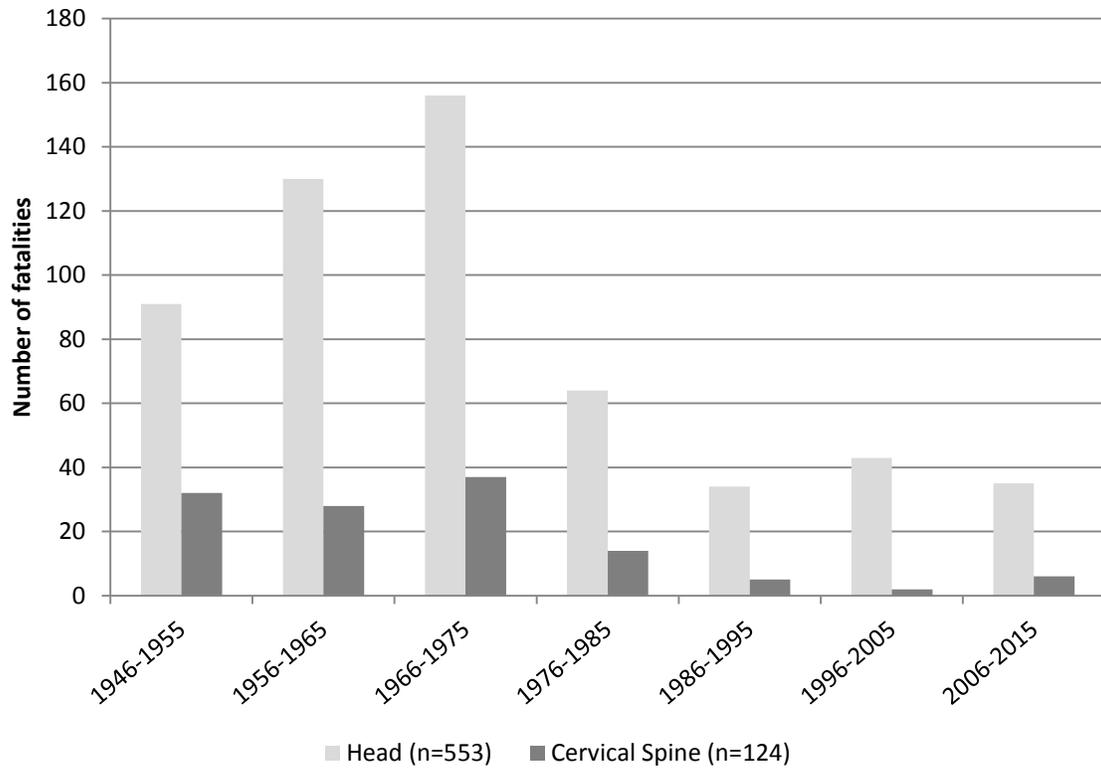


FIGURE II: NUMBER OF DIRECT AND INDIRECT FATALITIES BY 5-YEAR PERIOD,
1971 to 2015

