

ANNUAL SURVEY OF FOOTBALL INJURY RESEARCH

1931 - 2010

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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 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 while blocking and tackling was the direct result of this research.

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. This clearly illustrates that data collection and analysis is important and plays a major role in injury prevention.

Data Collection

Throughout the year, upon notification of a suspected football fatality, immediate contact is made with the appropriate officials (coaches, administrators, physicians, athletic trainers). Pertinent information is collected through questionnaires and personal contact.

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

Direct - Those fatalities which resulted directly from participation in the fundamental skills of football.

Indirect - Those fatalities that are caused by systemic failure as a result of exertion while participating in a football activity or by a complication which was secondary to a non-fatal injury.

In several instances of reported football fatalities, the respondent stated the fatality should not be attributed to football. Reasons for these statements are that the fatality was attributed to physical defects that were unrelated to football injuries.

Participation numbers were updated in the 1989 report. The National Federation of State High School Associations has estimated that there are approximately 1,500,000 high school, junior high school, and non-federation school football participants in the United States. The college figure of 75,000 participants includes the National Collegiate Athletic Association, the National Association of Intercollegiate Athletics, the National Junior College Athletic Association, and an estimate of schools not associated with any national organization. Sandlot and professional football have been estimated at 225,000 participants. These figures give an estimate of 1,800,000 total football participants in the United States for the 2010 football season.

Dr. Mueller compiled and prepared the survey report on college, professional, and sandlot levels, and Mr. Bob Colgate of the National Federation of State High School Associations assumed responsibility for collecting and preparing the senior and junior high school phase of the study. Sandlot is defined as non-school football, but organized and using full protective equipment.

At the conclusion of the football season, both reports are compiled into this **Annual Survey of Football Injury Research**. This report is sponsored by the American Football Coaches Association, the National Collegiate Athletic Association, and The National Federation of State High School Associations.

Acknowledgments

Medical data for the 2010 report were compiled by Dr. Robert C. Cantu, Chairman, Department of Surgery and Chief, Neurosurgery Service, Emerson Hospital, in Concord, MA. Dr. Cantu is a Past-President of the American College of Sports Medicine and is the Medical Director for the National Center for Catastrophic Sports Injury Research at the University of North Carolina at Chapel Hill.

Summary

1. There were five fatalities directly related to football during the 2010 football season. Two of the five fatalities were in high school football, two in college football, and one in sandlot football. (Table I)

2. The rate of direct fatal injuries is very low on a 100,000 player exposure basis. For the approximately 1,800,000 participants in 2010, the rate of direct fatalities was 0.27 per 100,000 participants.

3. The rate of direct fatalities in high school and junior high school football was 0.13 per 100,000 participants. The rate of direct fatalities in college was 2.66 per 100,000 participants. (Table III)

4. Most direct fatalities usually occur during regularly scheduled games. In 2010 the high school and sandlot fatalities occurred in games (3), one of the college injuries took place in the spring game and the other college injury took place in a spring practice.

5. The 2010 survey shows the high school injuries took place in October and November, the youth injury in September, and the college injuries in March and May.

6. The major activities in football would naturally account for the greatest number of fatalities. In 2010 one of the high school fatalities occurred when the athlete took a blow to the chest by the tackler and the second high school death involved the athlete having a re-bleed of a subdural hematoma that first happened three weeks earlier in a game. The youth athlete suffered second impact syndrome after having a concussion in a youth game one week prior to hitting his head

during recess at his middle school. One of the college players was tackling at the time of injury and the second was being blocked when an offensive lineman fell on top of him. (Table V)

7. In 2010 one of the high school fatalities resulted from injuries to the brain and the second to commotio cordis. The youth injury was a second impact brain injury. Both of the college fatalities were brain injuries. (Table VI)

8. In many cases football cannot be directly responsible for fatal injuries (heat stroke, heart related and so forth). In 2010 there were 11 indirect fatalities. Nine were associated with high school football, two with college football, and none in sandlot or professional football. The high school indirect deaths were two heat stroke, two heat/sickle cell trait, four heart related, and one associated with an asthma attack. One of the college indirect deaths was related to sickle cell trait and one was heart related. (Tables II & VIII)

Discussions And Recommendations

After a slight rise in the number of football fatalities during the 1986 season, the 1990 data revealed the elimination of direct football fatalities. That was the first time since 1931 that there have been no direct football fatalities at any level of play. The 2010 data continues the trend of single digit direct fatalities that started in the 1978 football season. The data illustrates the importance of data 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 elimination of football fatalities. Indirect injuries have been in double figures since 1999 with the exception of 2003 and 2007. The 2010 indirect fatalities show a decrease of four when compared to the 2009 data.

Head and Neck Injuries

Past efforts that were successful in reducing fatalities to the levels indicated from 1990 through 2010, and the elimination of direct fatalities in 1990, should again be emphasized. Rule

changes for the 1976 football season that eliminated the head and face as a primary and initial contact area for blocking and tackling is 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 the new 2005 definition in the rules “intentional” has been dropped. The new rule states “spearing is the use of the helmet (including the face mask) in an attempt to punish an opponent”. A 2006 point of emphasis covers illegal helmet contact and defines spearing, face tackling, and butt blocking. High school rule changes effective during 2006-07 stated that at least a 4-point chinstrap shall be required to secure the helmet, and all mouth guards must be colored, not white or clear. Also rule revisions regarding illegal helmet contact were made in February 2007. The committee placed butt blocking, face tackling, and spearing under the heading of “Helmet Contact – Illegal” to place more emphasis on risk-minimization concerns. 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. **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. In addition, if a catastrophic football injury case goes to a court of law, there is no defense for using this type of tackling or blocking technique.** Since 1960 most of the direct fatalities have been caused by brain and neck injuries, and in fact since 1990 all but six of the head and neck deaths have been brain injuries (69). We must continue to reduce head and neck injuries.

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

1. Athletes must be given proper conditioning exercises that will strengthen their necks in order to be able to hold their heads firmly erect when making contact.
2. Coaches should drill the athletes in the proper execution of the fundamental skills,

particularly blocking and tackling. **Contact should always be made with the head-up and never with the top of the head/helmet. Initial contact should never be made with the head/helmet or face mask.**

3. Coaches and officials should discourage the players from using their heads as battering rams when blocking and tackling. The rules prohibiting spearing should be enforced in practice and in games. The players should be taught to respect the helmet as a protective device and that the helmet should not be used as a weapon.
4. All coaches, physicians, and trainers should take special care to see that players equipment is properly fitted, particularly the helmet.
5. When a player has experienced or shown signs of head trauma (loss of consciousness, visual disturbance, headache, inability to walk correctly, obvious disorientation, memory loss), he should receive immediate medical attention and should not be allowed to return to practice or game without permission from a physician.
6. A number of the players associated with brain trauma complained of headaches or had a previous concussion prior to their deaths. The team physician, athletic trainer, or coach should make players aware of these signs. Players should also be encouraged to inform the team physician, athletic trainer, or coach if they are experiencing any of the above mentioned signs of brain trauma.
7. Coaches should never make the decision whether a player returns to a game or active participation in a practice if that player experiences brain trauma.
8. In 2008 the National Federation of State High School Associations stated in a concussion management recommendation the following: no athlete should return to play the same day of a concussion and must receive clearance from a medical professional before resuming practice or games. A 2010 change in the concussion rule states that any player who exhibits signs, symptoms, or behaviors consistent with a concussion shall be immediately removed from the game. The rule also requires that

the clearance to return to play be issued by an appropriate health-care professional.

The NFHS Football Rules Book has a special section “Suggested Guidelines for the Management of Concussion”. The NCAA Committee on Competitive Safeguards and Medical Aspects of Sports in a December 2009 meeting recommended that an athlete would be sidelined for at least the rest of the day if he/she loses consciousness or shows other worrisome symptoms during competition. The panel also recommended sidelining an athlete with less severe concussion-related symptoms until cleared by a doctor.

A major concern is second impact syndrome where an athlete who has not recovered from a concussion is returned to play and receives another severe hit. This situation most often results in death.

- 9. Game officials (referees) should call all illegal helmet contact in games. If they call all illegal helmet contact the number of concussions and catastrophic injuries may be reduced. Coaches will no longer teach improper techniques and players will no longer use their helmeted heads if they know a penalty will be called. At the present time officials are not calling all illegal helmet contact.**

Another important effort has been and continues to be the improvement of football protective equipment. It is imperative that old and worn equipment be properly renovated or discarded and continued emphasis placed on developing the best equipment possible.

Manufacturers, coaches, trainers, and physicians should continue their joint and individual efforts toward this end.

The authors of this research are convinced that the current rules which eliminate the head in blocking and tackling, **coaches teaching the proper fundamentals of blocking and tackling**, the helmet research conducted by the National Operating Committee on Standards for Athletic Equipment (NOCSAE), excellent physical conditioning, proper medical supervision, and a good data collection system have played the major role in reducing fatalities and serious brain and

neck injuries in football. This is best illustrated by Table IX and Graph I which shows the increase in both brain and cervical spine fatalities during the decade from 1965-1974. This time period was associated with blocking and tackling techniques that involved the head as the initial point of contact. The reduction in brain and cervical spine injuries is shown in the decade from 1975-1984. This decade was associated with the 1976 rule change that eliminated the head as the initial contact point in blocking and tackling. There is no doubt that the 1976 rule change has made a difference and that a continued effort should be made to keep the head out of the fundamental skills of football. Data from the decade 1985-1994 continues to illustrate the reduction in brain and neck fatalities. A concern is that the data from 1995-2004 show an increase in brain fatalities over that of 1985-1994. There has been an increase of 11 brain deaths during the decade 1995-2004, which is an increase of 2.1% over 1985-1994. The decade from 2005-2014 will have to be watched closely.

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. From 1960 through 2009 there have been 127 heat stroke cases that resulted in death (Table IV). **The 2010 data show four cases of heat stroke death at the high school level and none in youth, professional or college football. Two of the high school cases were also diagnosed as a combination of sickle cell trait and heat. There is no excuse for any number of heat stroke deaths since they are all preventable with the proper precautions. Since 1995 there have been 46 football players die from heat stroke (35 high school, 8 college, 2 professional, and one sandlot). Every effort should be made to continuously educate coaches concerning the proper procedures and precautions when practicing or playing in the heat.** Since 1974 there has been a dramatic reduction in heat stroke deaths with the exception of 1978, 1995, 1998, when there were four each year, and 2000, 2006, and 2008 when there were five each year. There were no heat stroke deaths in 1991, 1993, 1994, 2002,

and 2003. All coaches, trainers, and physicians should place special emphasis on eliminating football fatalities that result from physical activity in hot weather.

In addition to the above listed deaths due to heat stroke, in 2010 there were a number of cases where the players recovered. One such case was in Kentucky where six players from one school were taken to the hospital with heat exhaustion symptoms and one being kept overnight for observation. In another case a North Carolina coach made his players wear winter caps during August practice to acclimatize to the heat. None of the players suffered heat related problems, but medical experts stated that this type of practice was dangerous. In Oregon two dozen football players from one team went to the hospital complaining of sore and swollen muscles – including three who required surgery – suffering from a syndrome called rhabdomyolysis which occurs when athletes who have not been training have a sudden increase in the intensity of workouts during early practices. Heat and dehydration can trigger rhabdomyolysis.

Heat stroke and heat exhaustion are prevented by careful control of various factors in the conditioning program of the athlete. When football activity is carried on in hot weather, the following suggestions and precautions should be taken:

1. 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. Acclimatize athletes to heat gradually by providing graduated practice sessions for the first seven to ten days and other abnormally hot or humid days. Obey the rules pertaining to when full football uniforms may be used.
3. 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 and anytime the wet-bulb temperature is over 78 degrees practices should be altered.

4. Adjust activity level and provide frequent rest periods. Rest in cool, shaded areas with some air movement and remove helmets and loosen or remove jerseys. Rest periods of 15-30 minutes should be provided during workouts of one hour.
5. Provide adequate **cold** water replacement during practice. **Water should always be available and in unlimited quantities to the athletes. GIVE WATER REGULARLY.** Athletes should drink water before, during, and after practice.
5. Salt should be replaced daily and liberal salting of the athletes' food will accomplish this purpose. Coaches should not provide salt tablets to athletes. Attention must be directed to water replacement.
7. 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, a two to three percent body weight loss through sweating is safe, and a five percent loss is in the danger zone.
8. Clothing is important and a player should avoid using long sleeves, long stockings and any excess clothing. Never use rubberized clothing or sweatsuits.
9. Some athletes are more susceptible to heat injury. These individuals are not accustomed to work in the heat, may be overweight, and may be the eager athlete who constantly competes at his capacity. Athletes with previous heat problems should be watched closely.
10. 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. If heat illness is suspected, seek a physician's immediate service. Recommended emergency procedures are vital. Plan should be in writing and all personnel should have copies.

11. An increasing number of medical personnel are using a treatment for heat illnesses that involves immersing the athlete in ice water. This technique will help bring down the body temperature and has proven to be effective. Some schools have plastic outdoor swim pools filled with ice water available at practice facilities.
12. The National Athletic Trainers Association also has a heat illness position statement on their web site with recommendations for prevention.

Recommendations

Specific recommendations resulting from the 2010 survey data are as follows:

1. Mandatory medical examinations and medical history should be taken before allowing an athlete to participate in football. The NCAA recommends 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 Athletic Association.
2. All personnel concerned with training football athletes should emphasize proper, gradual, and complete physical conditioning. Particular emphasis should be placed on neck strengthening exercises and acclimatization to hot weather.
3. A physician should be present at all games and practice sessions. If it is impossible for a physician to be present at all practice sessions, emergency measures must be provided. Written emergency procedures are recommended for both coaches and medical staff.
4. All personnel associated with football participation should be cognizant of the problems and safety measures related to physical activity in hot weather.

5. Each institution should strive to have a certified athletic trainer who is a regular member of the faculty and is adequately prepared and qualified.
6. Cooperative liaison should be maintained by all groups interested in the field of Athletic Medicine (coaches, trainers, physicians, manufacturers, administrators, and so forth).
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 factor in football (rules, facilities, equipment, and so forth).
10. Coaches should continue to teach and emphasize the proper fundamentals of blocking and tackling to help reduce head and neck fatalities. **KEEP THE HEAD OUT OF FOOTBALL.**
11. Strict enforcement of the rules of the game by both coaches and 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.
12. When a player has experienced or shown signs of head trauma (loss of consciousness, visual disturbances, headache, inability to walk correctly, obvious disorientation, memory loss), he should receive immediate medical attention and should not be allowed to return to practice or game that day, and in future games or practices without permission from a physician.
13. The number of indirect heart related deaths has increased over the years and it is recommended that schools have automated external defibrillators (AED) available for emergency situations.

14. A more recent concern for indirect deaths in football players is sickle cell trait. A recent article mentioned that up to 13 college football players have died after a sickling collapse. The article also mentioned that most athletes do not know their sickle cell status even though screening is done at birth. A recent survey of NCAA Division I-A schools found that 64% screen their athletes for sickle cell trait. The National Athletic Trainers' Association has a statement on their web site – Consensus Statement: Sickle Cell Trait and the Athlete. The statement includes precautions applied to athletes with sickle cell trait.

CASE STUDIES DIRECT FATALITIES

HIGH SCHOOL

A 17 year-old high school football player was injured on October 28, 2010, and died on October 29, 2010. He collapsed on the sideline and was diagnosed with a brain injury (subdural hematoma). The autopsy report showed that he had a re-bleed of an earlier subdural suffered in a game on October 1, 2010. The original diagnosis was a concussion. He complained of headaches during the time of his first injury and his final injury. He was cleared by a physician to play in the game on October 28, 2010.

A 16 year-old high school football player was injured in a game and died on November 15, 2010. He caught a pass and was hit in the chest by an opposing player. While on the field he was administered CPR and use of an AED. Cause of death was commotio cordis.

SANDLOT

An 11 year old youth football player was injured in a game on September 3, 2010 and died on September 5, 2010. His injury in the game was diagnosed as a concussion. The injury that killed him happened during recess at his middle school when he accidentally hit his head while playing by the football sleds. Cause of death was possibly second impact syndrome.

COLLEGE

A 21 year-old college football player (NAIA) was injured during the spring game on May 8, 2010. He was injured on the last play of the game while making a tackle and taking a blow to the head. He suffered an acute subdural hematoma. He walked off of the field, but began vomiting on the sideline. He died later at the hospital.

An 18 year-old college football player (Division 2) suffered a brain injury during spring practice on March 27, 2010. He died on March 29, 2010. He was a defensive lineman being blocked and the offensive lineman landed on top of him as they fell to the ground.

CASE STUDIES INDIRECT FATALITIES

HIGH SCHOOL

A 16 year-old high school football player collapsed and died during an off season workout. CPR and an AED were used. He was 6' 4" tall and weighed 190 pounds.

Cause of death was cardiac arrhythmia

An 18 year-old high school senior collapsed on the field during a football scrimmage game on August 13, 2010. He was 5' 9" tall and weighed 165 pounds. There was no contact before his collapse. Cause of death was hypertrophic cardiomyopathy.

A 16 year-old high school football player collapsed later in the day after a morning football practice on August 11, 2010. Cause of the collapse was an asthma attack. He has suffered from asthma problems all of his life. He died on August 14, 2010.

A 15 year-old high school football player collapsed at practice on September 5, 2010. He died in the ambulance on the way to the hospital. Cause of death was a combination of heat and sickle cell trait.

A 15 year-old high school football player collapsed at practice on September 7, 2010. He was stretching at the time and fell back as he collapsed. He died later at the hospital. Cause of death was exertional sickling due to sickle cell trait and heat stress.

A 16 year-old high school football player collapsed after running sprints at the end of a practice session. He was 6'5" tall and weighed 315 pounds. He told the athletic

trainer he was not feeling well, but never told the coach. His core temperature was 108 degrees when medical help arrived at the field. Cause of death was heat stroke.

A 17 year-old high school senior football player collapsed on the sideline during a game. The date was September 17, 2010, and he died in the hospital. Cause of death was arrhythmogenic right ventricular cardiomyopathy.

A 16 year-old high school football player collapsed at practice on October 10, 2010. It was a no contact practice and players were dressed in helmets, shoulder pads, and shorts. The player became dizzy during the first 25 minutes of warm-up drills. He was 5'8" tall and weighed 300 pounds. Cause of death was a congenital heart defect.

A 16 year-old high school football player collapsed at practice on August 11, 2010, and died on October 12, 2010. Cause of death was heat stroke.

COLLEGE

A 22 year-old community college football player collapsed while running sprints in spring practice on April 6, 2010. It was 86 degrees and the humidity was 95%. Apparently he was not a member of the team and hoped to be a walk-on. He was observing practice, but ran with the team after practice to the gymnasium when he collapsed. Cause of death was believed to be sudden cardiac death.

A 20 year-old college football player (Division 1) collapsed and died during an early morning workout on February 19, 2010. Cause of death was sickle cell trait.

TABLE 1

FATALITIES: DIRECTLY DUE TO FOOTBALL – 1931-2010*

YEAR	SANDLOT DIRECT	PRO AND SEMIPRO DIRECT	HIGH SCHOOL DIRECT	COLLEGE DIRECT	TOTAL DIRECT
**1931-1965	134	72	348	54	608
1966	4	0	20	0	24
1967	5	0	16	3	24
1968	4	1	26	5	36
1969	3	1	18	1	23

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	15	0	18
1977	1	0	8	1	10
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	0	0	11	1	12
1987	0	0	4	0	4
1988	0	0	7	0	7
1989	0	0	4	0	4

TABLE 1 CONTINUED

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
TOTALS	179	78	676	88	1021

TABLE II

FATALITIES: INDIRECTLY DUE TO FOOTBALL - 1931-2010*

YEAR	SANDLOT INDIRECT	PRO AND SEMIPRO INDIRECT	HIGH SCHOOL INDIRECT	COLLEGE INDIRECT	TOTAL INDIRECT
**1931-1965	85	15	159	40	299
1966	0	0	6	2	8
1967	0	0	4	1	5
1968	2	0	8	2	12
1969	3	1	8	3	15
1970	0	0	12	2	14
1971	2	1	7	2	12
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	7	2	10
1977	0	0	6	0	6
1978	0	0	8	1	9
1979	1	0	8	1	10
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	0	0	4	3	7
1988	1	0	10	0	11
1989	0	0	9	2	11

TABLE 11 CONTINUED

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	1	0	7	1	9
1996	0	1	10	1	12
1997	1	0	7	0	8
1998	1	0	6	1	8
1999	1	0	11	0	12
2000	0	0	11	2	13
2001	0	2	10	3	15
2002	1	0	7	3	11
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	1	0	12	2	15
2010	0	0	9	2	11

TOTALS	114	23	471	114	722
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* No study in 1942 ** Yearly totals available from past reports

TABLE III
DIRECT FATALITIES INCIDENCE PER 100,000 – 1931-2010*

YEAR	HIGH SCHOOL	COLLEGE
**1931-1959		
1960	1.78	1.53
1961	1.62	9.23
1962	1.94	0.00
1963	1.94	3.04
1964	2.23	4.56
1965	2.00	1.33
1966	2.00	0.00
1967	1.60	4.00
1968	2.60	6.60
1969	1.64	1.33
1970	1.92	4.00
1971	1.25	4.00
1972	1.33	2.67
1973	0.58	0.00
1974	0.83	1.33
1975	1.08	1.33
1976	1.00	0.00
1977	0.53	1.33
1978	0.60	0.00
1979	0.23	1.33
1980	0.69	0.00
1981	0.38	2.67
1982	0.54	0.00
1983	0.30	0.00
1984	0.30	1.33
1985	0.30	1.33
1986	0.84	1.33
1987	0.30	0.00
1988	0.46	0.00
1989	0.27	0.00

TABLE III CONTINUED

1990	0.00	0.00
1991	0.20	0.00
1992	0.14	0.00
1993	0.20	1.33
1994	0.00	1.33
1995	0.27	0.00
1996	0.33	0.00
1997	0.40	1.33
1998	0.40	1.33
1999	0.27	1.33
2000	0.20	0.00
2001	0.46	0.00
2002	0.20	0.00
2003	0.13	0.00
2004	0.27	0.00
2005	0.13	0.00
2006	0.07	0.00
2007	0.20	0.00
2008	0.47	0.00
2009	0.13	0.00
2010	0.13	2.66

* **No study was made in 1942.**

** Yearly totals available from past reports.

Based on 1,500,000 junior and senior high school players and 75,000 college players.

TABLE IV**HEAT STROKE FATALITIES 1931-2010***

YEAR	TOTAL
**1931-1954	0
1955	1
1956-1958	0
1959	4
1960-1964	15
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	4
1996	2
1997	1
1998	4
1999	2

TABLE IV CONTINUED

2000	5
2001	3
2002	0
2003	0
2004	3
2005	2
2006	5
2007	2
2008	5
2009	4
2010	4**
TOTALS	132

* No study was made in 1942.

** Two were combination of heat and sickle cell trait

TABLE V**DIRECT FATALITIES 2010: TYPE OF ACTIVITY ENGAGED IN**

Type of Activity	Sandlot	Pro	High School	College	Total
Tackled After Catching Pass	0	0	1	0	1
Blocked	0	0	0	1	1
Collision	1	0	0	0	1
Tackling	0	0	0	1	1
Collapse	0	0	1	0	1
TOTAL	1	0	2	2	5

TABLE VI

DIRECT FATALITIES 2010: CAUSE OF DEATH

Causes	Sandlot	Pro	High School	College	Total
Brain Injury	1	0	1	2	4
Neck Injury	0	0	0	0	0
Commotio Cordis	0	0	1	0	1
TOTAL	1	0	2	2	5

TABLE VII

DIRECT FATALITIES 2010: POSITION PLAYED

Position	Sandlot	Pro	High School	College	Total
Wide Receiver	0	0	1	0	1
Defensive Back	0	0	0	1	1
Linebacker	0	0	1	0	1
Defensive Lineman	0	0	0	1	1
Unknown	1	0	0	0	1
TOTAL	1	0	2	2	5

TABLE VIII

INDIRECT FATALITIES 2010: CAUSE OF DEATH

Causes	Sandlot	Pro	High School	College	Total
Heart Related	0	0	4	1	5
Heat Stroke	0	0	2	0	2
Sickle Cell/Heat	0	0	2	0	2
Asthma Attack	0	0	1	0	1
Sickle Cell Trait	0	0	0	1	1
TOTAL	0	0	9	2	11

TABLE IX
HEAD AND CERVICAL SPINE FATALITIES

Year	Head		Cervical Spine	
	Frequency	Percent	Frequency	Percent
1945-1954	87	17.1	32	27.3
1955-1964	115	22.5	23	19.7
1965-1974	162	31.8	42	35.9
1975-1984	69	13.5	14	12.0
1985-1994	33	6.5	5	4.3
1995-2004	44	8.6	1	0.8
TOTALS	510	100.0	117	100.0