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Injuries In Youth Football: A Descriptive Two Year Study of Local South Carolina Football Leagues

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The National Football League and the NCAA have come out with a lot of studies in the past couple years looking at how playing football at this high of a level affects the well-being of the athletes. Because of this attention, there was been more focus on the younger kids that are starting out in football leagues at the age of 5 or 6 in hopes of making it to the professional leagues. Parents and coaches are now more concerned about how youth athletes playing rough sports, like football, become injured and how these effects can become evident later in life.

The Datalys Center is a sports injury and research prevention organization which works to increase safety for those that are participating in sports and are active. It was through the Datalys Center that USC Sports Medicine received funding to participate in this study. The University of South Carolina was one of seven different locations across the United States that was chosen to conduct research with youth football leagues.

As per instructions from the Datalys Center, it was required that one of the leagues being tracked as an age-weight league. This means that if the athlete was between a certain weight and a certain age, then they could play in a specific league. This is aimed to put kids who are developmentally closer against each other when playing football. The other league in the study was instructed to be an age-only league. This means that the athletes have to be within a certain age range to play in a particular league, regardless of their weight. One of the biggest questions that the age-only type of leagues bring up, is that kids who are substantially bigger are going up against kids who are a lot smaller even though they are the same age. Because of this fact, it may be hypothesized that youth athletes in the age-only leagues were getting hurt more often. This was one of the questions posed from this research project. The two leagues which USC Sports

Medicine worked with that filled the league type requirements were the Friarsgate Titans, and the Irmo Chapin Recreation Commission leagues, respectively.

Each league was given an athletic trainer who was to remain with the leagues for the entirety of their seasons. The athletic trainers went to every game and practice in order to diagnose and document every injury that occurred during the team session. The athletic trainers are also the ones to be first-responders if an emergency situation was to occur, as well as the ones who determine whether or not it is safe to practice due to environmental reasons. The athletic trainers are a vital part of this project because they are the ones who interact directly with the injured athletes and the parents. There are also research assistants who work with the athletic trainers when the athletic trainers need help. It is the athletic trainers' job to ensure that all of the necessary information about the injury incident is documented. The injury information is put into an online database provided by the Datalys Center. At this point in the project, there is two seasons worth of injury information in the database. The athletic trainers are responsible for diagnosing the injured athletes and handling stressful situations, but it also the athletic trainers' responsibility to determine when it is safe for the athletes to return to play after the injury. The athletic trainers working with the different leagues are the most vital part to this research project.

Working on this project has been very rewarding as it is easy to see the impact of interacting with the young athletes and helping them return to play after hurting themselves. However, there are a few aspects of this project that prove to be more of a challenge. Because this project involves working with a younger demographic, explaining situations in terms that they can understand proves to be difficult. Younger

athletes have a different perception of pain and have a hard time explaining what is bothering them. Because of this, it is important to realize how questions are asked in order to get the information that is necessary to complete an evaluation.

Even though this project has only been going on for two seasons, the impact has gained national exposure. The University of South Carolina has been at the forefront of injuries in youth football and hopes to expand this into different sports, like soccer, swimming, and baseball, in the upcoming seasons. It is the vision of USC Sports Medicine and athletic training to have certified athletic trainers at every major youth sports league. This project has been a rewarding experience for the past two seasons as it has helped to show the amount of work that must be put in, in order for the athletes to stay safe.

ABSTRACT

Objective: To collect and analyze injury data from two leagues in the Midlands area of South Carolina. One of the leagues is an age-weight league, meaning athletes have to be within a certain age range and weight range to play on a specific team. The other league was an age-only league, meaning athletes have to be within a certain range to play on a specific team. Results: For the two seasons that injury data was collected, the age-weight league had 208 injuries and the age-only league had 109. For both leagues, the majority of the injuries sustained were contusions. Each league had at least two instances when emergency transportation was needed because of the severity of the injury. Fifty-nine athletes injured in the age-only league returned to play during the same session they were injured. In the age-weight league 142 athletes returned to play during the same session. Because there was a comparison between an age-weight league and an age-only league, distributions across the age ranges were also analyzed. It was found that there was no significant correlation between the age of the athlete and injury rate. Discussion: A t-test was performed on the age-only league to see if there was a correlation between weight and the likelihood of having a concussion. The null hypothesis was that there was no correlation between the two factors. The p-value was small enough to determine that this test was not statistically significant and therefore failing to reject the alternative hypothesis that there is a correlation between the two factors. There was no correlation between the age of the athlete and the injury rate. The future of this project is to continue tracking the injuries in youth football and compare the injury rates further. Expansion to other sports, like soccer and basketball, can help to get a better holistic look at injuries at the youth level.

INTRODUCTION

In recent years, youth participation in sports has increased dramatically. It has been estimated that approximately 20-30 million kids from the ages of 5 to 17 years have participated in sports [11]. American football has followed these trends and is now one of the sports with the highest participation [10]. It has been estimated that approximately 10,793,000 kids between the ages of 5 and 17 years participate in youth football programs across the nation. Because of an increase in the amount of participation, there is also an increase in the amount of injuries for each sport, especially among football [11]. Both the National Football League (NFL) and college football programs have been under scrutiny because of the amounts of injuries that have occurred. Both leagues and high school football have been observed and research and new rules and regulations to reduce injuries have been implemented. However, the research on youth sports injuries for adolescents younger than high school age, especially football, is not as prominent.

The Datalys Center, a center for sports injury research and prevention, is the mother company in charge of the research initiatives for this study. There are seven other sites that are involved with this initiative to look more in-depth at injuries in youth football. Research initiatives, like the one through the University of South Carolina Athletic Training department, aim to look at the prevalence and incidence rates of injuries in youth football to combat some of the detrimental side effects of injuries. Specific injuries that are under close scrutiny include heat-related illnesses, musculoskeletal injuries and concussions.

Heat-Related Illnesses

Heat-related illnesses and injuries in sports have increasingly been shown more through the media. In a six-year span (1995 to 2001), there were 21 youth football players that succumbed to heat-related issues [1]. Heat-related issues can be attributed to many different aspects including hydration levels, core temperature values, and the environment. All of these factors can heighten a young athlete's response to the heat. Especially in the south, it is important to keep these factors in mind while working with young athletes. In order for the football athletes to stay adequately hydrated, it is important to allow them to have enough water breaks. Fluid balance is important in keeping the athlete safe. In a study about high school football athletes and fluid loss, it was found that if the athletes start the season dehydrated, it is hard for them to regain proper hydration throughout the preseason workouts and will in turn lose body weight and decrease the urine output [1]. All of these things can ultimately lead to severe dehydration and possible heat-related illness. It is important to acclimatize the teams to the weather in order to prevent a sudden spike in core body temperature [1]. It has been shown that football athletes are more likely to sustain heat-related illnesses at the beginning of the season rather than in the middle of the season or later on. Another reason to allow time for the athlete to adapt to the playing conditions is because when wearing the equipment without properly acclimating themselves, the athletes will work at a higher rate metabolically and the body cannot remain stable with the increase in heat production. Heat and humidity cause an increase in any of the issues so athletes need to be watched carefully throughout practices and games until they become acclimated to the weather [1].

Musculoskeletal Injuries

Musculoskeletal injuries are common in any sport, but are regularly reported in football. Because of the increase in the popularity of organized sports, there is a systematic increase in the amount of injuries that occur as well [9]. Younger athletes in organized sports are more susceptible to different injuries than older athletes because of physical, physiological, and psychological differences. Younger athletes in organized sports are more susceptible to injuries at the epiphyseal plates because of the laxity in the joints and ligaments [9]. Epiphyseal plates are the areas of the long bones that grow. They are also known as growth plates. When epiphyseal plates are injured, it can cause appendage length discrepancies. [9]. Intrinsic factors are factors that are specific to the individual whereas extrinsic factors that are specific to the environment in which the athlete participates. Examples of intrinsic factors include bone density and joint laxity. Examples of extrinsic factors include the weather and the playing surface [9]. There are other factors that also affect the injury rates in younger athletes. These factors include age and skill level.

Pre-pubescent athletes, and those younger than that, are not as likely to sustain musculoskeletal injuries as the older athletes. The older the athlete gets, the more likely they are to injure themselves. This can be reasoned to the fact that the level of competition increases as age increases. Also, with older athletes, they are usually stronger and bigger. With an increase in size and power, these athletes are more likely to injure themselves. Athletes with at least one severe injury, one that causes the athlete to be out of team activity for at least one day, are also more likely to be reinjured. This can be largely due to certain deficiencies from the first injury or not fully rehabilitating the

original injury [9]. Overall, multiple studies have shown that there is an increase in injuries in an athlete with an increase in age of the athlete. Skill level also greatly impacts the prevalence of injury, especially in football. One study conducted by the Sports Medicine Centre at the University of Calgary found that with an increase in skill, there is a decrease in injury prevalence [5]. This is related to the amount of training, the type of play, and the competitiveness of the league in which the athlete is playing.

In an observational study that was conducted by Dr. Barry Goldberg, the wrists and hands were the sites of most of the injuries in youth football, followed by the knee and the shoulder area [9]. The worst injuries occurred to the elbow, which include elbow dislocations. The upper extremity as a whole accounted for approximately 48% of the injuries whereas the lower extremity was only about 33%. The rest of the injuries occurred on unspecified areas. In the same study, fractures were the most common type of injury with the majority of the fracture injuries happening at the epiphyseal plates. When looking specific at positions, quarterbacks and running backs were most frequently injured as these positions are most often being chased or pursued [10]. Because of the increase in injuries like the ones mentioned above in youth football, this has caused an increase in the amount of athletes going to hospital emergency departments. This rate has increased throughout the years because of athletic participation and was estimated to be approximately 187,800 athletes in 2007 [3].

Concussions

Concussions are any disturbances to the brain that can cause differences in the mental, physical or emotional being of a person. Concussion research has been displayed very intensely throughout the media today. Concussions are found throughout any

contact sport, but football is responsible for the highest amount of concussions [2]. Kids participating in youth football have increased in size and power and because of this increase, there has been as increase in the number of kids that have been taken into emergency departments due to a sports-related traumatic brain injury. The US Center for Disease Control and Prevention has found that approximately 23,000 traumatic brain injuries from football result in hospital visits. Of those 23,000 injuries, nearly 90% are from kids between the ages of 5 and 17 years. Because of the prevalence of issues in the NFL and college football, concussion research in younger kids has increased. Recent studies have shown that repetitive concussions can lead to chronic traumatic encephalopathy which also can lead to an increase in tau proteins. These proteins have been linked to neurocognitive disorders like dementia as well as other cognitive issues like depression and personality changes [8]. Children participating in youth football have a higher change of getting these mental issues because they are exposed to head injuries earlier in life. With an increase in the number of concussions a kid sustains, there is an increase in the severity of the next concussion that occurs to the same kid. Because these severe complications can occur from concussions, it is important to teach kids from a very young age to hit correctly. All of the states in the United States have enacted legislation to focus on the kids that are getting concussions and other sports-related traumatic brain injuries in order to protect them and allow them to recover completely before returning to play. States have been enacted this legislation since 2011. This helps to ensure that the participants will not have to suffer from repeated concussions and ultimately any neurological issues that may have come from these concussions.

Second Impact Syndrome has also been attributed to multiple concussions. Second Impact Syndrome occurs when two or more severe concussions happen within a short amount of time and the brain does not have a chance to heal completely. This can lead to brain swelling and occasionally, death. The largest percentages of people who die from Second Impact Syndrome are children and adolescents [8]. There are many reasons as to why this might happen. Such reasons can include that younger kids have weaker neck muscles and larger heads or that these kids were not taught how to tackle properly [8]. There have been hypothesis stating that there is a "super-hero effect" that has caused an increase in concussions as well as other injuries to football players and other sports that require protective equipment. Since the players are required to wear protective equipment, they believe that they are protected from forces that can cause injury. This mindset may cause the athletes to become more aggressive which causes a drastic increase in injury rates for these athletes [8]. At the Virginia Institute of Technology and Wake Forest University, there was a study that tracked the acceleration of hits in youth football as well as the prevalence of concussions in the leagues using accelerometers in the participant's helmets [4]. This study found that more concussions were sustained during practice. This is largely due to the number of practices versus the number of games per season and that the magnitudes of the hits during the games were higher than during practice causing the participant to sit out prematurely during the game. It was also found that the greatest amount of linear acceleration was found when the impact was to the top of the head [2]. This study is instrumental in trying to implement rules and regulations for the youth leagues to lessen the prevalence of concussions.

The reason for the push in proper concussion diagnosis and referral is because there are no specific guidelines to follow in order to diagnose a concussion. Concussion symptoms vary from person to person and no one person exhibits the same signs and symptoms from the same hits. There have been many pieces of legislation that have been put into place in order to protect football players from getting too many concussions. Such laws have been put into place in 26 different states saying that there should be certified athletic trainers to assess and diagnose concussions and determine whether or not those athletes should be allowed to return to play [4]. In the state of Washington, the government implemented a law called the Lystedt Law. This law requires very strict guidelines as to when to return to play after receiving a concussion because a 13-year-old suffered from second impact syndrome [8]. Even the NFL has implemented different pieces of legislation and has partnered up with the Center for Disease Control and Prevention for a campaign called "Head's Up". This campaign raises awareness for concussion safety especially at the younger ages. In 2010, as a way to promote proper behaviors so professional athletes could lead by example for the younger crowds, the NFL has hung up posters in each locker room that says "Work smart. Use your head, don't lead with it. Help make our game safer. Other athletes are watching…" Because of the severity of concussions, it is important that all athletes are protected and these different types of legislation and community work will help ensure that.

The importance of injury prevention studies is paramount because they help active youth in the United States stay healthy through prevention. By knowing the causes of specific injuries, especially in youth football, it will help coaches, officials, and parents know the signs of injuries and help to combat those injuries.

METHODS

For the current study, injury data were collected from two different football leagues in the Midlands area of South Carolina. Data were collected for the 2012 and 2013 seasons. One of the leagues that was being studied was an age-weight league and the other was an age-only league. The players in the age-weight league were placed on teams based on their age and weight, so that players at the same maturity and development stage go up against one another. The players in the age-only league were placed on teams based on their age, regardless of their developmental status. Before the season started, both leagues were instructed to have the athletes sign an assent form and have the parents or legal guardians of the athletes sign a consent form for the athletes to receive medical attention provided by the athletic trainers in case of injury. In both leagues, injuries can range from bruises to concussions and fractured bones. With each injury, information about the injury was collected by the graduate athletic trainers that were assigned to work with the respective leagues. The information collected included the time and location of the injury, the mechanism of injury, which side the injury occurred, and any descriptive information about the injury. The athletic trainers were the emergency responders for each of the leagues and were the main point of contact for anything medical related. These trainers also diagnosed any injury and administered preventative actions as seen fit.

Once the injury data were collected, it was then entered into a database provided by the Datalys Center. This database also provided a place to enter all of the games and practices and the weather conditions for these events, as well as the number of athletes present at each sporting event. There was also a space to count the number of plays each

player had during a game session. At the end of each season, the data from each league were compiled and analyzed by the Datalys Center to compare the information to the other sites participating in the research study.

The database was used to compare the gathered information between the two sites in the Midlands area. Information specific to the injury, such as date and location, mechanism of injury, body part, specific injury, and field surface, was collected based on the specific players over the course of two seasons. The injury information was then de-identified and compressed in an excel spreadsheet before it was analyzed in _____, a statistical analysis software.

RESULTS

The injury data were collected and statistically analyzed using the program ____. The results were analyzed to find the number of occurrences and the percentage of the total injuries that have occurred. Below are the results of the statistical analyses.

Table 1 Type of Injury

	AGE-ONLY LEAGUE		AGE-WEIGHT LEAGUE	
INJURY	NUMBER OF OCCURRENCES	PERCENTAGE	NUMBER OF OCCURRENCES	PERCENTAGE
Contusion	37	33.94	91	43.75
Concussion	10	9.17	3	1.44
Sprain	21	19.27	38	18.27
Solar Plexus Injury	5	4.59	2	0.96
Abrasion	4	3.67	5	2.4
Spasm	2	1.83	1	0.48
Gamekeeper's Thumb	4	3.67	4	1.92
Tear	6	5.5	8	3.85
Dehydration	2	1.83	0	0
Fracture	9	8.26	4	1.92
Anxiety	1	0.92	0	0
Epitaxis	1	0.92	4	1.92
GI Disorder	1	0.92	0	0
Heat Exhaustion	1	0.92	8	3.85
Hip Pointer	1	0.92	0	0
Impingement	1	0.92	0	0
Laceration	1	0.92	1	0.48
Other Injury	1	0.92	1	0.48
Soleus Tendinosis	1	0.92	0	0
Dislocation	0	0	1	0.48
Achilles Tendonitis	0	0	1	0.48
Calcaneal Apophysitis	0	0	1	0.48
Headache	0	0	17	8.17
Heat Cramps	0	0	3	1.44
Hyperextension	0	0	2	0.96

Jammed Finger	0	0	2	0.96
Knee Pain	0	0	2	0.96
Lateral Epicondylitis	0	0	1	0.48
SI Dysfunction	0	0	1	0.48
Strain	0	0	1	0.48
Turf Toe	0	0	1	0.48
Whiplash	0	0	4	1.92

This table shows the frequency of different injury types for the Age Only league. These data were collected over two seasons from 2012-2013.

Table 1 presents the frequency of the various injuries experienced for the athletes registered in the age-only and the age-weight leagues. Of the 109 injuries reported for the age-only league, the most popular were contusions, concussions, and sprains. The vast majority of the injuries occurred only once. Of the 208 injuries reported for the age-weight league, the most popular injuries were contusions, sprains, and headaches.

Table 2. Practice/Game

	AGE-ONLY LEAGUE		AGE-WEIGHT LEAGUE	
LOCATION	FREQUENCY	PERCENT	FREQUENCY	PERCENT
Game	60	55.05	89	42.79
Practice	49	44.95	119	57.21

This table shows the frequency of injuries in both the game and practice setting for the two leagues. These data were collected over two seasons from 2012-2013.

Table 2 presents the frequency of the injuries reported for both of the leagues in this study. In the age-only league, the majority of the injuries occurred during games. In the age-weight league, the majority of the injuries occurred during a practice situation.

Table 3. Return to Play

	AGE-ONLY LEAGUE		AGE-WEIGHT LEAGUE	
TIMEFRAME	FREQUENCY	PERCENT	FREQUENCY	PERCENT
Same Session	59	54.13	142	68.27
1-6 Days	24	22.02	29	13.94
7-13 Days	12	11.01	6	2.88
14-29 Days	5	4.59	2	0.96
Removed from Team Activity	5	4.59	26	12.5
Out for Remainder of Season	3	2.75	2	0.96
Unknown	1	0.92	0	0

This table shows the amount of time that the youth athletes needed to return to play after an injury. These data were collected from the age-weight and age-only leagues over two seasons from 2012-2013.

Table 3 presents the rate of returning to play after an injury sustained in both the age-weight league and the age-only league. For both leagues, over 50% of the injuries allowed the injured athlete to return to play within the same session in which they were injured.

Table 4. Mechanism of Injury

	AGE-ONLY LEAGUE		AGE-WEIGHT LEAGUE	
MECHANISM	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
Direct Contact	89	81.85	130	62.5
No Apparent Contact	8	7.34	26	12.5
Illness	5	4.59	1	0.48
Indirect Contact with Another Person	4	3.67	17	8.17
No Specific Mechanism	2	1.83	21	10.10
Gradual Onset	1	0.92	2	0.96
None	0	0	7	3.37
Other	0	0	4	1.92

This table shows the mechanism of injury for the injuries that occurred in the age-weight and age-only leagues. These data were collected over two seasons from 2012-2013.

Table 4 presents the mechanism of injury for those youth athletes that were injured during the two seasons that the data were collected. For both leagues, the majority of the

injuries occurred because of direct contact. For the age-weight league, approximately a quarter of the injuries did not have a specific mechanism or no apparent contact.

Table 4.1. Type of Direct Contact

	AGE-ONLY LEAGUE		AGE-WEIGHT LEAGUE	
TYPE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
Contact with Another Person	67	61.47	100	48.08
Contact with Playing Surface	16	14.68	28	13.46
Contact with Playing Apparatus	6	5.5	2	0.96

This table shows the breakdown of the types of direct contact in mechanisms of injury. These data were collected from the Seven Oaks league over the course of two seasons from 2012-2013.

Table 5.1 shows the specificity of the mechanism of injury for those who had a direct contact injury. For both the age-only league and the age-weight league, the largest portion of the injuries happened because of contact with another person, followed by contact with the playing surface.

Table 5. Team – Age-Only League

TEAM	FREQUENCY	PERCENTAGE
Bills	19	17.43
Chargers	15	13.76
Titans	15	13.76
Steelers	14	12.84
Texans	13	11.93
Raiders	8	7.34
Falcons	6	5.5
Packers	6	5.5
Rams	5	4.59
Vikings	4	3.67
Seahawks	3	2.75
Cowboys	1	0.92

This table shows the frequency of injury for each team in the age-only league. These data were collected over the course of two seasons from 2012-2013.

Table 5 presents the distribution of injuries for each team over the course of two seasons for the age-only league. The Bills had the most injuries, while the Cowboys had the least. The range of injuries per team is quite large because not all teams participated in both seasons.

Table 5.1. Team – Age-Weight League

TEAM	FREQUENCY	PERCENTAGE
Junior Midget	41	19.71
Junior Pee Wee	42	20.19
Junior Pee Wee Blue	6	2.88
Junior Pee Wee White	2	0.96
Mighty Mite Red	27	12.98
Mighty Mite White	38	18.27
Pee Wee	34	16.35
Tiny Mite	18	8.65

This table shows the frequency of injury for each team in the age-weight league. These data were collected over the course of two seasons from 2012-2013.

Table 5.1 presents the distribution of injuries for each team over the course of two seasons for the age-weight league. The Junior Pee Wee team had the most injuries at 42, while the Junior Pee Wee White had the least amount of injuries at 2. The range of injuries per team is large because not all teams participated in both seasons. In the age-weight league, some of the teams combined for the second season.

Table 6. Age

	AGE-ONLY LEAGUE		AGE-WEIGHT LEAGUE	
AGE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
5-7	0	0	18	8.65
7-9	0	0	65	31.25
8-10	50	45.87	50	24.04
9-11	0	0	34	16.35
11-14	59	54.13	41	19.71

This table shows the frequency of injuries dependent on age. These data were collected from the Seven Oaks league over the course of two seasons from 2012-2013.

Table 6 presents the distribution of injuries based upon age for the age-only and the age-weight leagues. The age-only leagues only had two divisions for their athletes, whereas

the age-weight league had five age divisions. For the age-only league, the injuries were distributed fairly evenly between the 8-10 and 11-14 age groups. The age-weight league had the most injuries in the 7-9 year old age group.

A T-Test was also performed to determine if there was a correlation between the weight of the youth athlete and the likelihood of getting a concussion. This t-test was performed for the age-only league. There were not enough data points to perform the same test with the age-weight league. The null hypothesis for this t-test was that a difference in weight does not increase concussion occurrence. After performing the t-test, the average weight of an athlete who was concussed in the age-only league was 107.5 pounds with a standard deviation of 31.13 pounds. There were ten athletes out of the 109 that did receive a concussion. Of those youth athletes who were not concussed, the average weight was 109.6 pounds with a standard deviation of 36.11 pounds. Of the 109 athletes that were injured, 99 of them were not concussed. The p-value for the t-test was 0.8608, meaning that this test was not statistically significant. Based off of this t-test, we failed to reject null hypothesis; there is no difference in the rate of concussions based upon weight.

DISCUSSION

During the 2012 season, there were 235 athletes participating in the age-only league with 12 teams that had an average of 19 players per team. The age-weight league had 152 athletes on 7 teams with an average of 22 players per team during the same season. During the 2013 season, the age-only league had 177 participants on 9 different teams with an average of 19 players per team. The age-weight league had 141 athletes on 6 different teams with an average of 24 players per team during the 2013 season. Of the injuries sustained over the two seasons at the age-only league, there were 109 injuries. Contusions were the most common type of injury that occurred, with concussions being the next most common type of injury. There were only two instances when emergency services were needed because of the severity of the injury. A talar fracture and a tibial fracture were the two types of injuries that needed emergency services. Both of these injuries caused the athletes to be out for the remainder of the season. For the age-weight league, there were 208 injuries that occurred. Of those injuries, contusions were the most common type. There were two injuries that required emergency transportation. The first injury was an ankle dislocation that needed immediate surgery. This injury caused the athlete to be out for the rest of season. The second injury that needed emergency transportation was a heat-related issue that escalated quickly to a probable heat stroke. This athlete was out for a week before he returned to practicing with his team.

When comparing the injury occurrences in the practice or game setting, 55% of the injuries occurred during a game situation while 45% occurred during a practice at the age-only league. In the age-weight league, 57% of the injuries occurred during a practice situation and 43% occurred during a game situation. Because there was not a significant

difference between the two numbers in both of the leagues, it cannot be determined if youth athletes are more likely to be hurt during games or practices. With each injury, there is a recovery period. For the two seasons that the age-only league had the injuries tracked, 54.13% of the injuries allowed the athlete to return to play during the same session, whether it is during the practice session or the game in which they were injured. The age-weight league had 68% of the injured participants return to play during the same session. Both leagues are lower than the average of 90% of the athletes returning to play during the same session. There were only three injuries that caused the athletes to stop playing football for the remainder of the season in the age-only league, while in the age-weight league, only two injuries caused the athlete to be out for the rest of the season. The rest of the injuries ranged anywhere from 1-29 days to return to play.

The mechanism of injury is important in determining how to keep youth athletes safe while playing their sport. In the age-only league, it was found that direct contact was the main mechanism of injury with 89 (81.65%) of the injuries resulting from direct contact. Direct contact includes with another person (61%), with the playing surface (14.68%), and with the playing apparatus (5.5%). This is compared to the 130 injuries that occurred because of direct contact in the age-weight league. Of these 130 injuries, 100 were because of contact with a person, 28 were because of contact with the playing surface, and 2 were because of contact with a playing apparatus. Because this is a younger demographic and they are more resilient, there was only one gradual onset injury in the age-only league and there were two gradual onset injuries. Based upon age, in the age-only league, the younger age group of 8-10 year olds was injured 50 times over the two seasons, whereas the older age group of 11-12 year olds was injured 59 times over

the two seasons. In the age-weight league, there were more divisions of age. The age group that had the most injuries for the age-weight league was the 7-9 year old group with 65 injuries. The group that had the least amount of injuries was the 5-7 year old group with 18 injuries. For the entire age-weight league, there was not a large range of number of injuries. There was also no correlation with the injury rate and age, whether the correlation was positive or negative.

The injury rates were also broken down based upon each team to determine if there was one team that was getting injured more frequently than another team. Differences in team injury rates can be related to the coaching style of the head coaches and the environment that the coaches and the parents create for the team. The injury rates for each team in the age-weight league ranged from 1-19 injuries for the age-only league with each team having around 21 players. During the 2012 season, there were 12 teams, while during the 2013 season, there were only nine teams. The difference in the number of teams per season can attribute to the range of injuries. There was not one team that had a significantly higher number of injuries, meaning that the coaching styles of the teams were similar in injury prevention techniques. The age-only league also used the Heads Up technique to teach tackling so there was uniformity across the coaching styles. For the age-weight league, the injury rates for each team ranged from 2-42 injuries with each team having around 27 players per team. Like the age-only league, in the 2012 season, there were eight teams but in 2013, there were six teams. There was not a distinct difference between the teams in the age-weight league. Unlike the age-only league, this league did not use the Heads Up technique to teach tackling, but at the beginning of every season, there is a coaches' meeting where there is an overview of how to properly tackle.

This coaches' meeting helps to ensure that all of the teams in the league are consistent in how to teach tackling, especially because some of the athletes in this league are as young as 5 years old.

There are many sources of error in this research project because of the nature of the demographic upon which this project is based. Children cannot always perceive pain the same way that someone older can because they are not as aware of their body yet. Many times when asking the youth athletes in this study how much pain they were in on a scale of 1-10, they would give scores of seven or above, not really understanding the differences between the numbers. This affects the data because the athletic trainers were not able to get an accurate identification of the injury that did occur. Also, because these athletes could not perceive pain well, they had issues deciding whether they were hurt but could continue to play or injured and could not return to play. A lot of the youth athletes came over with a minor bump or bruise, even though they were not hurt, because they could not perceive how much pain they were having. Another source of error when working with this population was that they have a hard time conveying what they were feeling. Plenty of times, when asked by the athletic trainers, the injured athlete could not articulate what happened to cause the injury or what exactly hurts. During a few instances, the athletic trainer would ask probing questions only to find that the athlete would answer either yes or no to every question. The trainers could not get a good diagnosis from these responses. Because the youth athletes in this study were not aware of their bodies and how injured or hurt they were, it was hard to get an accurate diagnosis of the injury. Therefore, the youth athletes were the biggest source of error during this study.

Because this study was conducted over the course of two seasons up to this point, there have been multiple athletic trainers who have worked with the leagues. Another source of error that may bias the results is how the athletic trainers diagnose the injuries. In the age-weight league there were only three diagnosed concussions. One concussion was diagnosed in the 2013 season, while the other two were diagnosed in the 2012 season. The age-only league had 10 concussions evenly dispersed over the two seasons. In the age-weight league, there were 17 headaches diagnosed, while in the age-only league there were none documented over the two seasons. What is most interesting about this large difference between the two leagues is that all of the documented headaches in the age-weight league were diagnosed in the same season by the same athletic trainer. Twelve of the 17 headaches were caused by direct contact of some sort, while the other five headaches had no specific mechanism or no apparent contact. Five of these headaches were removed from the team activity and one was removed from play for 1-6 days after the injury. Many times a headache is one of the first signs of a concussion. Because of the sensitivity of some people to head impacts, it is important for athletes to have a full concussion test to ensure that a headache is not in fact a concussion. In the future, it is important to implement a protocol for when to test for a concussion because of the long-term effects of having brain injuries. This can help to account for bias in the injury data as well as help to properly treat the athletes that have headaches versus an actual concussion.

This study, being the first of its kind, is instrumental in determining how youth athletes are getting hurt. Because of the prevalence of long-term injury effects in the media, this research project helps to look at how the athletes are getting hurt and how

these injuries may affect the athletes later in life. Through this study, it was found that there is no correlation between the weight or age of the youth athlete and the likeliness of them sustaining an injury. It was found that the majority of the injuries that were found were in fact, contusions and most athletes returned to play within the same session in which they were hurt. These realizations can be used to help implement guidelines for different leagues as to how to prevent more serious injuries. As this study continues to take place, it can be used to track athletes that participate in the leagues for multiple seasons. This project also explains the importance of having an athletic trainer or other medical profession at the practices and games. Because these individuals can diagnose injuries, it can help those who get severely injured receive the care that they need as soon as possible. This project is also being conducted in different spots across the nation so the data collected can be used to see if there are regional differences and then help figure out a way to combat these issues nationally. There has been a lot of injury research conducted nationally, at the college level, and in some high schools, but there has not been an opportunity to look at the youth level and this project is an in-depth look at two leagues in the Midlands area to see injury trends.

In the future, the research project at the University of South Carolina hopes to expand into different sports, including soccer, baseball, and swimming. The same type of injury collection will occur. The relationships with the youth football leagues in the Midlands area of South Carolina will continue past these two seasons. It is the hope of USC Sports Medicine to have certified athletic trainers with every major youth sports league in the Midlands area. Eventually, there will be a youth sports injury research center located in Columbia, South Carolina.

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