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An Epidemiological Look at Injuries among High School Athletes Participating in a Variety of Sports for Both Sexes

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By

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Abstract

Physical activity is part of a healthy lifestyle, but participating in athletic activities like team sports can lead to injury. This study was designed to find the differences in types of high school sports injuries and how frequently these injuries occur among different sports and between males and females. A survey was given to members of the football, boys' basketball, girls' basketball, baseball, softball, and volleyball teams of a central Appalachian high school. The highest rate of injury was found in girls' basketball at 86.7%, followed by football at 85.2%, boys' basketball at 70.6%, softball and volleyball each at 69.2%, and baseball at 33.3%. Significant differences were also found between the most prevalent types of injuries in each sport. Differences in types of injuries were reported by male and female athletes who participated in comparable sports such as boys' and girls' basketball and softball and baseball. More research into why these differences exist could result in more individualized prevention strategies for high school athletes.

Introduction

Although the physical activity that comes with being a student athlete can be incredibly beneficial to an athlete's health, according to *USA TODAY*, student athletes sustain approximately 1.35 million injuries that are serious enough to require medical treatment each year (Healy, 2013). These injuries cost nearly US$935 million (Healy). Many of these athletes make full recoveries and are even able to play sports again. However, every year several deaths are also caused by sports-related accidents. Finding associations between injuries and a specific sport or athlete's sex could help coaches and health care professionals develop new ways to prevent injuries and could save students' health and finances.

More Student Athletes, More Sports Injuries

According to the National Federation of State High School Associations (NFSHSA), for the past 26 years, the number of high school students participating in sports has been increasing. In the 2014-2015 school year, the NFSHSA reported that just over 7.8 million high school students participated in athletics (Sprecher, 2015). Of these 7.8 million athletes, approximately 3.3 million are girls and 4.5 million are boys (Sprecher). The number one sport chosen by female athletes during the 2014-2015 school year was track and field, followed by volleyball, basketball, soccer, softball, cross-country, tennis, swimming/diving, and cheerleading in the top ten (Sprecher). Many students also participate in other non-traditional sports such as archery and riflery. For boys, the top sport is eleven-player football, followed by track, basketball, baseball, soccer, wrestling, cross country, tennis, golf, and swimming/diving. The number of participants in each sport varies by state with Texas reporting the greatest number of athletes at a little over 800,000 (Sprecher).

Studies have been conducted to show the relationship between sports-related activities and injury. In an article published in the *American Journal of Sports Medicine,* an epidemiological study assessed how many injuries were sustained by military personnel due to exercise and sports-related activities. The authors of this study found that 49% of military personnel sustained injuries at some point during their career and 52% of the injuries sustained were due to exercising or participating in sports activities outside of their normal duties (Hauret et. al., 2015). Many of these injuries were severe enough to require at least 2 weeks of limited activity. This study concluded that sports related injuries had a significant effect on a population of otherwise healthy individuals (Hauret).

This relationship is also seen in high school athletes. As more high school students are choosing to participate in sports, more sports-related injuries are reported each year. Approximately 2 million high school athletes are injured each year. Of these 2 million, 500,000 require physician visits and 30,000 require hospital stays. Students ages 15years to 17 years have the highest rate of injures requiring physician visits (http://www.swata.org/statistics). The data collected by the U.S. Consumer Product Safety Commission's National Electronic Injury Surveillance System showed that the most common injury in all sports for elementary, middle, and high school students were ankle injuries accounting for nearly 15% of all sports injuries (Healy, 2013). Head injury was the second most common at 14%. Injuries to the knee, fingers, and face were also common (Healy). These data only included injuries seen by emergency room physicians; the data did not include visits to urgent care centers or primary care physicians.

The increase in the number of student athletes and the subsequent increase in number of sports-related injuries create a greater need for more efficient injury reporting systems and effective prevention strategies. By collecting data that show injuries more likely to occur among

specific individuals playing specific sports, injury prevention could be more individualized. Different strategies could be developed for specific team positions or player genders that have a higher rate of certain injuries.

Musculoskeletal Injuries

The majority of the injuries sustained during sports-related activities are injuries to the musculoskeletal system (e.g., tendon and ligament tears, muscle strains and broken bones). These injuries are fairly common in individuals who participate in athletic activities. Injuries to the lower extremities are the most commonly reported injuries in most sports. A study published in the *Journal of Athletic Training* followed fifteen different sports teams over a period of sixteen years and found that lower extremity injuries (e.g., knee injuries, muscle strains, and the most common, ankle injuries) comprised more than 50% of all reported injuries (Hootman & Agel, 2007). The ankle joint was found to be the most frequently injured part of the body in sports, comprising 15% of all reported injuries (Hootman & Agel).

Concussions

The types of injuries that occur during sports--related activities vary. Concussions have been the focus of media attention in recent years. Approximately 300,000 athletes sustain concussions each year, and for individuals ages 15 years to 24 years, sports are the second leading cause of concussions, following motor vehicle crashes (Marar, McIlvain, Fields & Comstock, 2012). The recent media attention has prompted rule changes in several sports, particularly contact sports like American football, but studies have shown that concussions occur across a variety of sports including those sports not classified as full-contact sports (Marar,

et.al.). Severe concussions can have long term effects (e.g., memory loss, behavior changes, and decreased cognitive function; brainhealth.utdallas.edu).

A study published in the *American Journal of Sports Medicine* reported that athletes do not always report their injuries to coaching or training staff. Concussions are among these unreported injuries (Kerr, Register-Mihalik, Kroshus, Baugh, & Marshall, 2015). From the data collected, the researchers found that approximately 27% of the survey participants recalled experiencing at least one concussion (Kerr, et. al.). Of these, 33% reported that this injury was nondisclosed (Kerr, et. al.). The study found that football players were the mostly likely to have had a concussion that was not reported to training staff, and male athletes were more likely overall to have a nondisclosed concussion than female athletes. The study participants reported several reasons for not reporting their injuries, the most common being that they did not want to leave the game or practice and they did not want to let down the team (Kerr et. al.). Not reporting a concussion prevents coaches and trainers from following protocols that protect athletes' health. If players suffer a concussion but do not tell coaching staff, they might continue playing and cause further injuries.

Internal Abdominal Injuries

Though much less common than concussions or musculoskeletal injuries, internal injury is a serious concern, particularly in contact sports. In recent years, news stations have reported athlete deaths, usually football players, due to blunt force trauma that caused internal bleeding. Lacerations or ruptures of internal organs such as the spleen, liver, or kidney can cause rapid blood loss that quickly leads to shock (Ralston & Scherm, 2004). However, not all blunt force trauma to the abdomen causes serious organ damage. Sometimes a blow to the upper abdomen

(i.e., where a bundle of nerves known as the solar plexus is located) can cause a temporary, quickly resolved paralysis of the diaphragm, making breathing difficult and often causing the injured athlete to panic (Barrett & Smith, 2012). This scenario is usually quickly resolved and athletes' discomfort subsides when they begin to calm (Barrett, et. al.). Medical and athletic training staff on the sidelines must pay careful attention to any athlete who suffers a blow to the abdomen because serious internal injury is not always immediately recognizable. Examination by a physician is recommended for anyone who could possibly be at risk for traumatic organ damage (Barrett, et. al.).

Prevalence of Specific Injuries in Different Sports and by Gender

Several studies have been conducted comparing injury rates between sports and genders. A study published in the *American Journal of Sports Medicine* surveyed a population of high school athletes to determine injury rates in different sports. By soliciting data on student athletes' injuries from athletic trainers at 100 different high schools, the authors of this study found that football had the highest rate of injuries, followed by wrestling, girls' basketball, and girls' soccer (Darrow, Collins, Yard, & Comstock, 2009). They also found that the average injury rate across all sports was higher for boys than for girls, but when comparable sports were considered separately, girls sustained more serious injuries than boys. They reported that fractures were the most common severe injury across all sports followed by complete ligament sprains. Almost 1/3 of severe injuries required surgery and over half of these surgeries were on the knee joint (Darrow, et. al.).

The *Journal of Sports Science and Medicine* published an article in 2009 that looked specifically at the risk of injuries for males and females. Researchers conducted a survey to

calculate the rates of injuries for both sexes in several different sports. Initially, the raw data showed that males reported more acute injuries than females, but when the number of hours each athlete spent in either practice or competition was compared, the rates of injury per 1000 hours were nearly the same (Ristolainen, Heinonen, Waller, & Kettunen, 2009). Some small differences were found between the rates of injury for males and females in each sport, but overall the authors concluded that most of the differences could be explained by differences in the number of hours each individual athlete spent in training. A positive association was found between the number of hours spent training and the injury incidence rates (Ristolainen, et. al.).

Some studies have taken these similar methods a step further by examining whether the most common sports injuries are more likely to occur during practice or competition. They found that the rate of injury during competitions was 4.63 per 1000 athletes while the rate during practice was 1.69 (Rechel, Yard, & Comstock, 2008). Football was once again found to have the highest injury rate with competition injury rates being significantly higher than practice (Rechel, et. al.). They also found higher rates of injuries to the head, face, and neck during competitions than practice (Rechel, et. al.). The authors concluded that providing these findings to athletic trainers could help them develop evidence based programs to prevent injuries in the future.

Methods

This study was designed to answer the question, “Are there significant differences in injuries that occur in different sports and to men and women athletes?” This descriptive epidemiological study collected information from a population of student athletes who participated in football, boys’ basketball, girls’ basketball, volleyball, baseball, and softball at a central Appalachian high school.

The six teams used in the sample were chosen based on prior knowledge of the prevalence of injuries in these sports as well as the need for comparability. Three boys' teams and three girls' teams were selected to better allow for comparisons between genders. Boys' and girls' basketball, softball, and baseball were chosen because they are comparable sports. Football was chosen because it is known to have a large number of injuries every season, and volleyball was added because it was the only other all girls sport offered at the high school and is also known to produce a significant number of injuries. Every member of each of these teams, both varsity and junior varsity, was invited to participate in the study.

Instruments

The survey was comprised of 8 questions designed to measure the relationships between certain types of injuries and the sports in which they occurred. It also addressed whether or not injuries were reported to a coach or member of the training staff and whether or not medical treatment was required.

Data Collection

The materials needed to conduct this study were passive parental consent forms and the 8-point questionnaire. The passive parental consent forms were designed in accordance with the East Tennessee State University Institutional Review Board, and were given to coaches a week before the survey was to be administered. The coaches for each of the six chosen sports teams were asked to give a form to each member of their teams and instruct them to take the form home to their parents or guardians. The parents were instructed to read the form and return it only if they wished to prevent their children from participating in the study. Each of the coaches agreed to distribute the forms.

On the day the survey was given, the students who played one or more of these sports were called out of class and asked to report to the high school's auditorium. They were instructed to sit with at least one seat between themselves and their neighbors. Once everyone was seated, the risks, benefits, and instructions were read aloud to the entire group. Time was allowed for questions to be asked and answered before the survey was given. Once each participant had been given a survey packet, they were allowed ten minutes to answer all eight questions. When time ran out, an envelope was given to the individual at the end of each row and each participant placed his or her own questionnaire into the envelope. The last individual in the row was asked to seal the envelope. After all of the envelopes were collected, the participants were dismissed to return to their classrooms.

Several measures were put in place to ensure that each individual invited to participate in the survey was aware of all of their rights, all of the procedures, and that the information they provided would remain completely confidential. Every aspect of the study was approved by the Institutional Review Board at East Tennessee State University.

Data Analysis

The answers to each of the questions were entered into a spreadsheet. Types of injury was divided into seven categories: 1. Wrist/Hand, 2. Arm/Forearm, 3. Ankle/Foot, 4. Thigh/Leg, 5. Head/Neck, 6. Chest/Abdomen, 7. Back. Injuries to the elbow and shoulder joint were included in the arm/forearm category, knee injuries with thigh/leg, and clavicular injuries with chest/abdomen. Frequencies, measures of central tendency, cross tabulations, and chi squares were calculated to answer the research questions.

Results

A total of 107 completed surveys were collected on the day of data collection (Table 1).

Table 1. Number of Participants in Each Sport

	Number	Percent of Total
Football	54	41.5
Boys' Basketball	17	13.1
Girls' Basketball	15	11.5
Softball	13	10.0
Baseball	18	13.8
Volleyball	13	10.0

Of these, 86 individuals reported being injured at some point during their high school sports careers. (Table 2).

Table 2. Number Injured in Each Sport

	Number Injured	Percent of Team	Percent of Total Injured
Football	**46**	**85.2%**	**55%**
Boys' Basketball	**12**	**70.6%**	**14.5%**
Girls' Basketball	**13**	**86.7%**	**15.7%**
Softball	**9**	**69.2%**	**10.8%**
Baseball	**6**	**33.3%**	**7.2%**
Volleyball	**9**	**69.2%**	**10.8%**

Several athletes reported multiple injuries; a total of 184 different injuries were reported (Table 3).

Table 3. Number of Injuries to Each Body Part

	Number Injured	Percent of Total Injuries
Wrist/Hand	**18**	**12.3%**
Arm/Forearm	**20**	**13.7%**
Ankle/Foot	**41**	**28.1%**
Thigh/Leg	**46**	**31.5%**
Head/Neck	**10**	**6.8%**
Chest/Abdomen	**6**	**4.1%**
Back	**5**	**3.4%**

Of the 86 athletes that reported being injured while playing their sport, softball players reported the highest rate of wrist/hand injuries at 36.4% followed by girls' basketball, baseball, football, boys' basketball, and volleyball, respectively (Table 4). Softball also had the highest rate of arm/forearm injuries; baseball had the lowest number of arm/forearm injuries. For injuries to the ankle/foot, baseball players reported the highest rate at 70% and softball players reported the lowest rate of ankle injuries. Boys' basketball players reported the highest rate of injury to the leg and thigh at 80%, followed by softball, football, baseball, girls' basketball, and volleyball. Over 17% of football players reported injuries to the head or neck, followed by baseball, softball, girls' basketball, and boys' basketball. No volleyball players reported head/neck injuries. Baseball players had the highest rate of chest/abdomen injuries at 20%, followed by softball, girls' basketball, and football. Neither boys' basketball nor volleyball had any reports of chest/abdomen injuries. Baseball also reported the highest rate of back injuries, followed by softball. There were no back injuries reported by volleyball players.

Table 4. Injury rate by injured body part and sport

	Wrist/hand	**Arm/ forearm**	**Ankle/foot**	**Thigh/leg**	**Head/neck**	**Chest/ Abdomen**	**Back**
Football	21.7%	26.1%	45.7%	60.9%	17.4%	6.5%	2.2%
Boys' basketball	20.0	26.7	60.0	80.0	6.7	0.0	6.7
Girls' basketball	30.8	15.4	53.8	38.5	7.7	7.7	7.7
Softball	36.4	27.3	36.4	72.7	9.1	9.1	9.1
Baseball	30.0	10.0	70.0	40.0	10.0	20.0	10.0
Volleyball	12.5	12.5	50.0	37.5	0.0	0.0	0.0

Of all injuries reported by football players, 33.7% were injuries to the thigh/leg (Table 5). Thigh/leg injuries also had the highest reported percentage in boys' basketball at 40%. The largest category for girls' basketball injuries was injuries to the ankle/foot at 33.3%. In softball, 36.4% of all reported injuries were in the thigh/leg category. Baseball reported 36.8% ankle/foot injuries. Volleyball had the highest percentage of ankle/foot injuries at 44.4%.

Table 5. Injury rates within sports

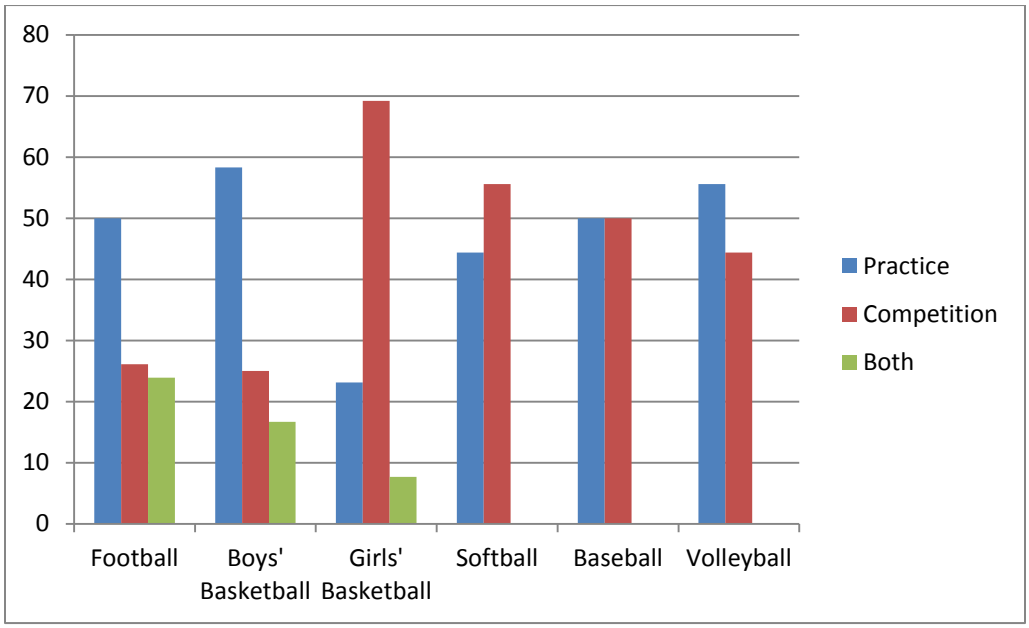
	Football	**Boys' Basketball**	**Girls' Basketball**	**Softball**	**Baseball**	**volleyball**
Wrist/hand	12.0%	10.0%	19.0%	18.2%	15.8%	11.1%
Arm/forearm	14.5	13.3	9.5	13.6	5.3	11.1
Ankle/foot	25.3	30.0	33.3	18.2	36.8	44.4
Thigh/leg	33.7	40.0	23.8	36.4	21.1	33.3
Head/neck	9.6	3.3	4.8	4.5	5.3	0.0
Chest/abdomen	3.6	0.0	4.8	4.5	10.5	0.0
Back	1.2	3.3	4.8	4.5	5.3	0.0
Total	100%	100%	100%	100%	100%	100%

In both football and basketball, the majority of injuries reported occurred during practice (Table 6). Some athletes recalled having been injured during both practice and competition. In softball, baseball, and volleyball, injuries occurred with similar frequencies in practice and competition. Softball had a few more injuries in competition and volleyball had a few more during practice. Girls' basketball players reported significantly more injuries occurring during competition than in practice.

Table 6. Percentage of Injuries Occurring in Practice vs. Competition

	Practice	Competition	Both
Football	50%	26.1%	23.9%
Boys' Basketball	58.3	25.0	16.7
Girls' Basketball	23.1	69.2	7.7
Softball	44.4	55.6	0.0
Baseball	50.0	50.0	0.0
Volleyball	55.6	44.4	0.0

Figure 1. Percentage of Injuries Occurring in Practice vs. Competition



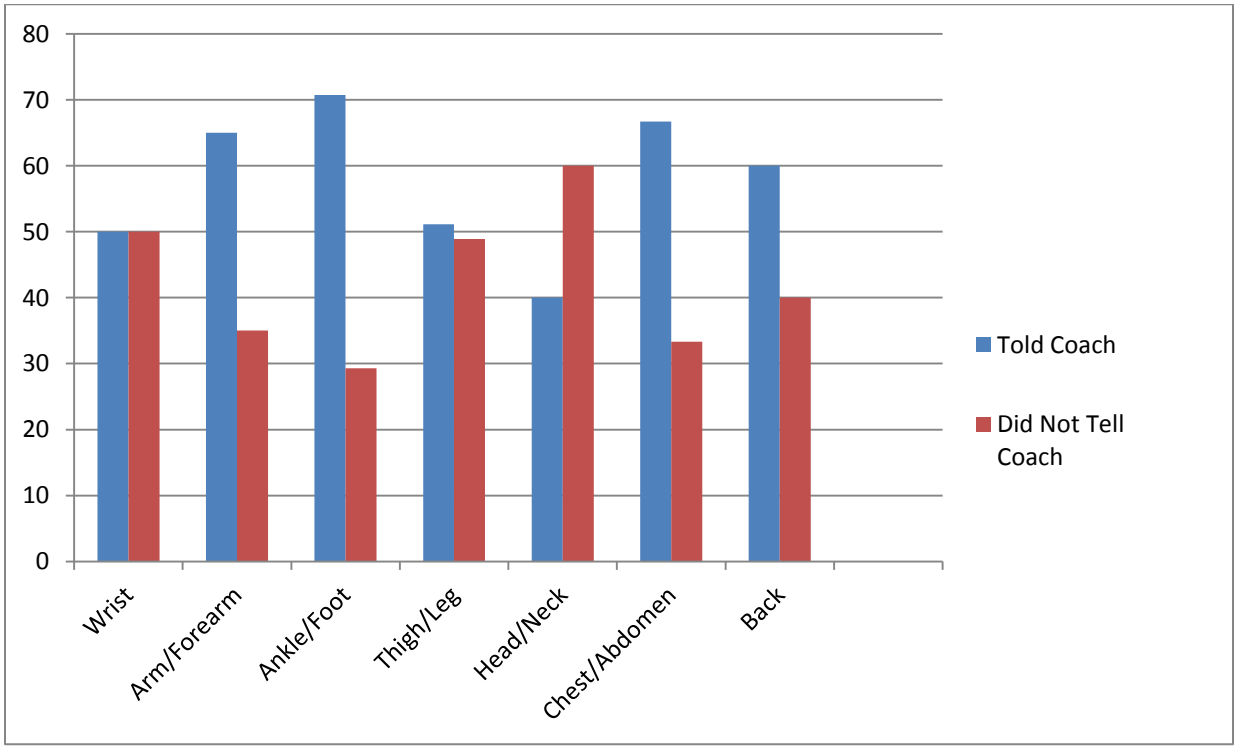
Each athlete was asked whether or not they reported their injury to a coach or member of the training staff. When analyzed according to what part of the body was injured (Table 7), the data showed that individuals with injuries to the ankle/foot, chest/abdomen, and back were more likely to tell their coach that they were hurt. For athletes with wrist and thigh/leg injuries,

approximately half told a coach and half did not. Athletes with arm/forearm and head/neck injuries were less likely to report them to a coach. Sixty-five percent of arm/forearm injuries and 60% of head/neck injuries were not reported.

Table 7. Percentage of Athletes Reporting Injury to Coach vs. Body Part Injured

	Told Coach	Did Not Tell Coach
Wrist/Hand	50.0%	50.0%
Arm/Forearm	65.0	35.0
Ankle/Foot	70.7	29.3
Thigh/Leg	51.1	48.9
Head/Neck	40.0	60.0
Chest/Abdomen	66.7	33.3
Back	60.0	40.0

Figure 2. Percentage of Athletes Reporting Injury to Coach vs. Body Part Injured



The "tell coach" variable was also analyzed with each sport (Table 8). Approximately 60% of individuals who were injured in football, boys' basketball, girls' basketball, and baseball reported their injuries to their coaches. Eighty-five percent of volleyball players told a coach when they were injured. Softball was the only sport for which the athletes were less likely to inform a coach about an injury. Approximately 55% did not tell their coach after they were injured. Although most girls' basketball players did report their injuries to a coach, they were less likely to tell a coach than the boys' basketball players.

Table 8. Percentage of Athletes Reporting Injury to Coach vs. Sport

	Told Coach	**Did Not Tell Coach**
Football	58.7%	41.3%
Boys' Basketball	66.7	33.3
Girls' Basketball	61.5	38.5
Softball	44.4	55.6
Baseball	66.7	33.3
Volleyball	85.7	14.3

Figure 3. Percentage of Athletes Reporting Injury to Coach vs. Sport

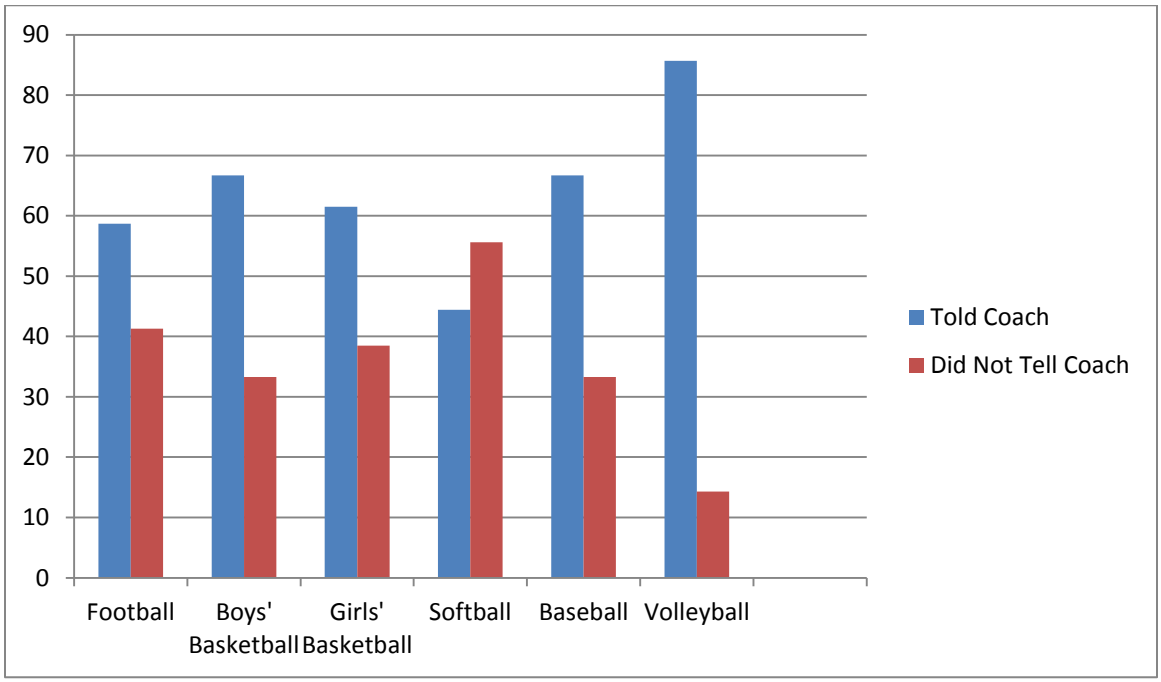
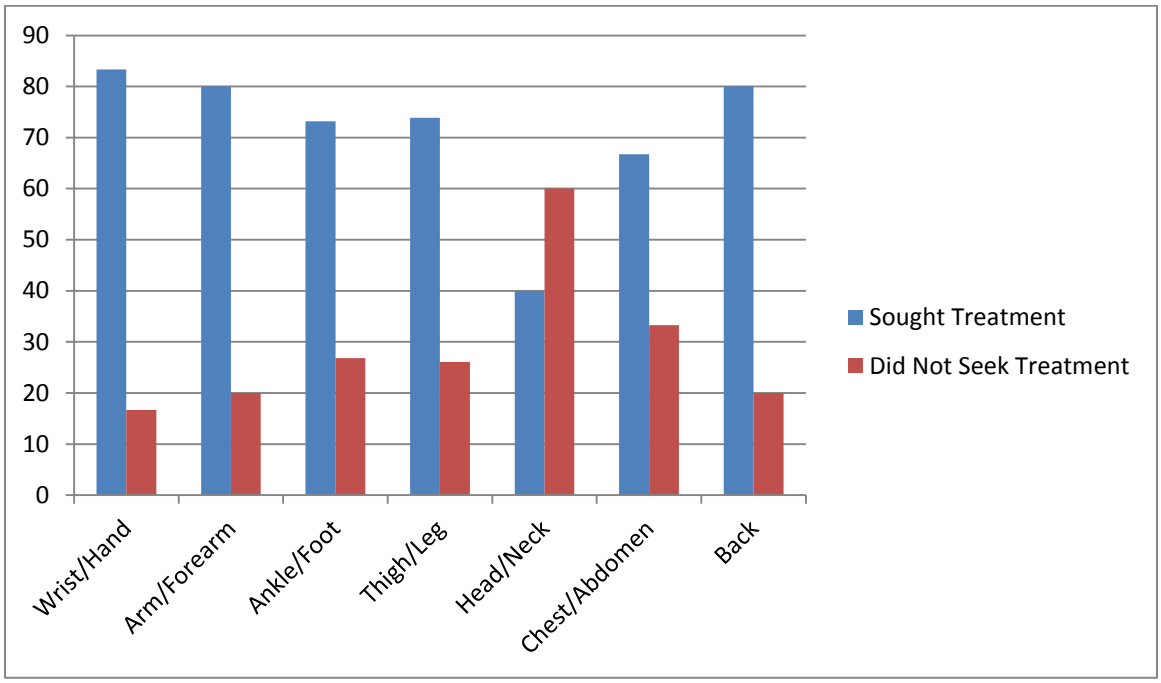


Table 9. Percentages of Athletes Seeking Medical Treatment by Injured Body Part

	Sought Treatment	**Did Not Seek Treatment**
Wrist/Hand	83.3%	16.7%
Arm/Forearm	80.0	20.0
Ankle/Foot	73.2	26.8
Thigh/Leg	73.9	26.1
Head/Neck	40.0	60.0
Chest/Abdomen	66.7	33.3
Back	80.0	20.0

Figure 4 shows that most of the injured athletes sought medical treatment for their injuries. However, 60% of individuals with head and neck injuries did not seek medical treatment.

Figure 4. Percentages of Athletes Seeking Medical Treatment by Injured Body Part



Individuals in all six sports were very likely to seek medical treatment for their injuries. The percentage of girls' basketball players seeking treatment for their injuries at 92.3% was significantly higher than the percentage of those who did not seek treatment ($p<.05$) (Table 10).

Figure 5. Percentages of Athletes Seeking Treatment vs. Sport

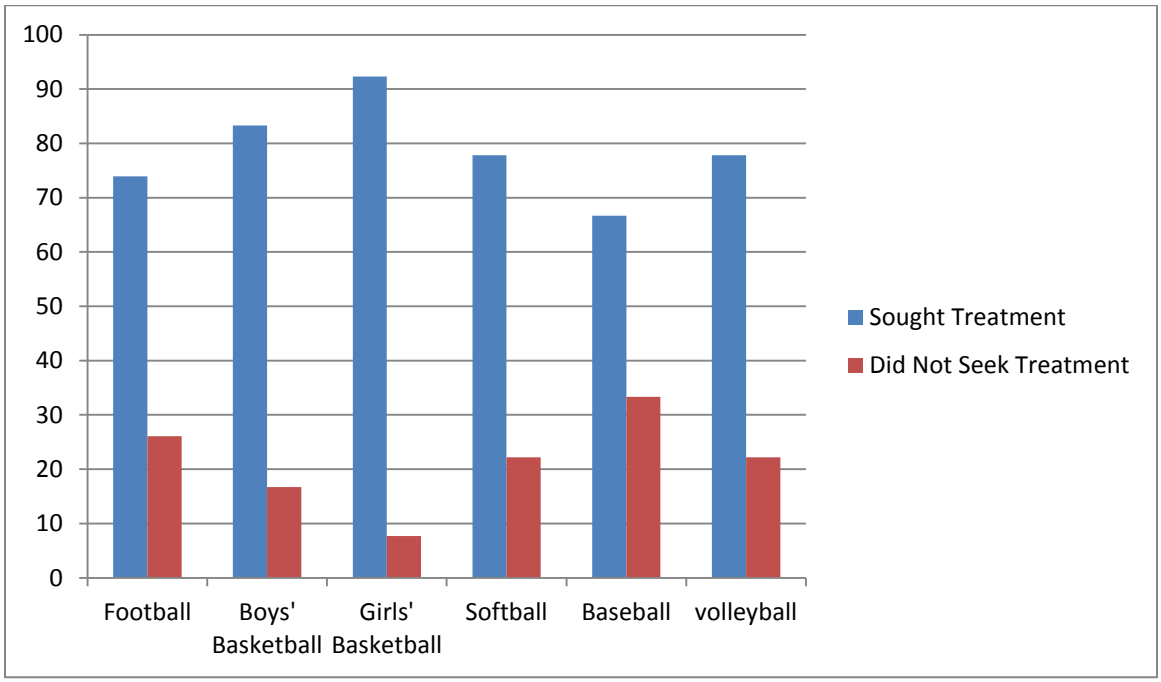


Table 10. Percentages of Athletes Seeking Treatment vs. Sport

	Sought Treatment	Did Not Seek Treatment
Football	73.9%	26.1%
Boys' Basketball	83.3	16.7
Girls' Basketball	92.3	7.7
Softball	77.8	22.2
Baseball	66.7	33.3
Volleyball	77.8	22.2

Discussion

Of the 107 completed surveys, 77.6% of these reported experiencing at least one injury and nine of them reported more than one injury. Within the sample population, 66.4% of participants were male and 33.6% were female. Fifty-five percent of total injuries reported were football injuries, however, this value is skewed because football players comprise 41.5% of the total sample population. Each sport, with the exception of baseball, had a large percentage of players report injuries. Girls' basketball was the highest at 86.7%, followed by football at 85.2%, boys' basketball at 70.6%, and softball and volleyball at 69.2%. The percentage of injured baseball players was significantly lower at 33.3%.

The large percentage of football injuries is not entirely surprising, because past research on full contact sports such as football has a high likelihood of injury to players. However, girls' basketball had an even larger percentage of their team members report injuries. These data became even more interesting after further analysis revealed that more than 90% of these injuries required medical treatment. It is unclear why baseball players reported so few injuries, especially compared to the comparable female sport of softball. There is much less player-to-player contact in baseball, which makes injury seem less likely, but if this is the case, why is softball so much higher?

The largest number of injuries was in the thigh/ leg category which comprised 31.5% of total injuries including muscular injuries, fractures, and injuries to the knee joint, which were fairly common, especially in football. This finding differs from previous studies which reported injuries to the ankle joint as being the most common (Hootman, Darrow). Injuries to the

ankle/foot were a close second, comprising 28.1% of all injuries. These injuries were followed by injuries to the arm/forearm, wrist/hand, head/neck, chest/abdomen, and back.

When examining the number of injuries to certain body parts by sport during which the injury occurred, it becomes evident that some injuries are more prevalent in certain sports. The highest rates of injury to the wrist/ hand and the arm/forearm occurred in softball. Softball players often experience overuse injuries to the upper extremities, particularly the shoulder, due to the way the game is played. Baseball players reported the highest rate of ankle injuries; 70% of the injured members of the team had experienced an ankle injury, while softball reported the lowest percentage at 36.4%. The highest rate of injury to the thigh/leg was reported in boys' basketball. Unsurprisingly, the highest rate of head/neck injuries occurred in football, however, head injuries were reported in every sport with the exception of volleyball. The highest rate of both chest/abdomen and back injuries were reported in baseball. Many of the chest injuries were fractured collar bones.

By comparing the body part injured with the sport in which the injury occurred, it is possible to see some differences in the data between males and females, particularly in comparable sports. The highest rate of arm/forearm injuries occurred in softball players, while the lowest rate was seen in baseball. This finding could be due to the differences that exist between the two sports. For example, pitching in softball is quite different from pitching in baseball, and employs more extensive rotation of the shoulder joint. The highest rate of ankle injuries was reported by baseball players, while softball players reported the lowest. The reasons for this are slightly less clear, but baseball fields are larger than softball fields, which require more running. No other obvious differences in the way the two games are played would lead to the expectation of more ankle injuries in baseball. The highest rate of thigh/leg injuries happened

in boys' basketball, while in girls' basketball the second lowest rate was reported followed only by volleyball. This fact is interesting because the two sports are essentially the same other than the fact that one is played by females and the other males. Does this suggest that males are more susceptible to this type of injury?

Within each sport, the types of injuries reported by the athletes varied. The most common injuries in football, boys' basketball, and softball were injuries to the thigh/leg. However, variance between these sports was found as well. Football players reported several knee injuries, particularly tears to the ACL, MCL, and meniscus. Knee injuries were reported in basketball as well, but basketball players reported more leg fractures than the other sports. In the case of softball, several of the reported thigh and leg injuries were muscle strains and contusions. This variance could possibly be at least partially explained by the characteristics of the sports themselves. Football produces twisting of the knee joint, particularly in offensive and defensive linemen, that can lead to knee injury. Basketball requires more vertical jumps than other sports, and players are more likely to "land funny" after a jump, which can lead to fracture. Several softball players reported large, painful bruises caused by being hit with a ball. More evidence is needed to support these assumptions, but there are some inherent differences in the sports that might cause certain types of injuries, even though the most common injuries in all three of these sports fell into the thigh/leg category.

The largest category of injuries in girls' basketball, baseball, and volleyball was ankle/foot. Unlike the other three sports, these three did not show as much variance of injuries within the category. Although a small number of fractures to the ankle or foot were reported, the vast majority of ankle/foot injuries in these three sports, (and also the ankle/foot injuries in the other sports) were ankle sprains. Like the other three sports, all three of the games have inherent

differences. Perhaps the commonality of injuries results from the instability of the ankle joint. Previous research has suggested that ankle sprains are the most common injury across all sports. The ankle is a weight bearing hinge-like joint that has a partially restricted range of motion, and is highly affected by movements outside of its typical range of motion (http://teachmeanatomy.info/lower-limb/joints/the-ankle-joint).

Across all six sports, most athletes recalled their injuries occurring during practice. Girls' basketball and softball, however, reported that more than half of their injuries occurred during competition. Football and boys' basketball had a substantial number of players who reported multiple injuries, and therefore recalled being injured in both practice and competition. The likelihood of an injury occurring during practice is increased because more time is spent in practice than in competition. The football team at this high school spends approximately 10 hours per week in practice and three hours in competition. Also, many of the athletes practice daily, such as the freshmen, but spend very little time on the field during competition. This scenario is true for the other sports as well, although freshmen are more likely to participate in competition, but still nearly 70% of girls' basketball and 55% of softball injuries occurred during competition.

An important aspect of sports injury research is whether or not the injury is reported to a coach or training staff member. In six of the seven categories of injury in this study, more than half of the injuries were reported. However, only 40% of head/neck injuries were reported, meaning 60% were not reported. This finding is quite concerning, specifically in the case of concussions, because further play could significantly worsen the injury and cause permanent brain damage. Many rule changes have occurred, particularly in contact sports such as football, to prevent this situation from occurring, but because of this, players know that reporting a

possible concussion guarantees they will not return to play during that game. This nuance makes it incredibly important for coaches and training staff to quickly recognize the signs of a concussion and be attentive to all players to ensure that no player can hide a concussion and return to play.

The data also showed that for five of the six teams studied, more than half of the athletes reported their injuries to a coach. Softball, however, was the exception, with only 44% claiming to have reported their injuries. Although most girls' basketball players did report their injuries, the data showed that they were less likely to report injuries than boys' basketball players. This finding could possibly be due to girls not wanting to be treated like typical "girls". To a person outside of the sports world, it might seem like girls would be more likely to report their injuries because they are not able to "play through the pain" as well as boys. This fact in itself might cause female athletes to refrain from reporting injuries, so that they will not be seen as inferior to boys. However, not all girls' teams were less likely to report their injuries. Volleyball players actually had the highest rate of reporting injuries at almost 86%.

The final aspect of this study examined whether or not athletes sought medical treatment for their injuries. The need for medical treatment might suggest the severity of some injuries. In most injury categories, a substantial percentage of the injuries were reported. However, 60% of players with head injuries did not seek any medical treatment or examination. This is the same percentage of head/neck injuries that were not reported and lends evidence to the belief that many athletes who do not report head/neck injuries to a coach, might also keep it from their parents or guardians, and in turn are not urged to seek medical consultation. When analyzed by sport, the data showed that most injuries did require medical treatment; 92% of injuries to girls' basketball players required medical treatment, nearly 10% higher than in boys' basketball. Also,

boys' basketball was the second highest at 83%. As mentioned earlier, basketball players reported more fractures than the other sports, which would require more medical attention, but this fact does not explain the difference between males and females.

Some issues could have affected the data that were collected from these surveys. By having the athletes self-report their injuries, discrepancies could exist between what two players believe constitutes an injury. This limitation could also be true for receiving treatment. One student might see treatment as having an ankle examined, wrapped, or iced by a member of the training staff, while another student might believe that visits to a health care provider in a hospital or clinic count as medical treatment. In further research, clearer definitions of some of these terms might increase the accuracy of self-reporting.

Despite these issues, the data showed that injuries are prevalent in all six of these sports, and many of them require medical treatment. Creating more strategies for injury prevention could decrease the prevalence of injuries and possibly decrease the severity of the injuries that do occur.

Recommendations

Prevention of injuries should be a primary concern of coaches and athletic trainers. For the effective development and implementation of prevention strategies, more in depth sport specific, sex specific, and injury specific research must be conducted. The data involving comparable sports, (i.e., boys' basketball, girls' basketball, softball, and baseball) provided some evidence that the injuries experienced by boys and girls in similar sports are significantly different. Research with the goal of explaining why this occurred would be a step further in the development of specific prevention strategies for the most prevalent injuries in these sports.

Further research could also be conducted to determine why so many girls' basketball and softball injuries occurred during competition while all the other sports had more injuries during practice, and why both boys' and girls' basketball players were more likely to require treatment than other athletes. Research projects such as this one address the "what" of the problem; what types of injuries are happening to whom? Further research to determine why injuries occur in this way and how to prevent injuries should be the next step.

Concluding Remarks

Injuries occur in all sports. Some prevention strategies and rule changes have been implemented but injuries still occur. By conducting research such as this to find the types of injuries that happen to specific individuals, more specific research can be undertaken to create more specialized approaches to injury prevention. Though a variety of injuries were reported across all six of the teams included in this study, specific injuries were more prevalent in each individual sport. Differences between sexes, particularly in comparable male and female sports (e.g., the difference in the number of leg injuries between girls' and boys' basketball, or arm injuries in baseball and softball) and although some exceptions were found, were significant. If further research could determine why these differences exist, and how to best prevent these types of injuries in the future, the school could benefit financially by reducing the number of hospital visits and most importantly, the health of the student athletes could be improved.

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