

**DO ATHLETIC TRAINERS HAVE A POSITIVE IMPACT ON HIGH SCHOOL  
ATHLETES' KNOWLEDGE OF INJURY PREVENTION  
AND TRAINING HABITS?**

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## ABSTRACT

# **DO ATHLETIC TRAINERS HAVE A POSITIVE IMPACT ON HIGH SCHOOL ATHLETES' KNOWLEDGE OF INJURY PREVENTION AND TRAINING HABITS?**

By

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The purpose of this study was to determine if athletic trainers have a positive impact on high school athletes' knowledge of injury prevention strategies and/or their incorporation of that knowledge into practice. A survey was distributed to incoming college freshmen athletes during their pre-participation physical. The survey contained demographic data and question blocks that assessed (a) the subject's knowledge of an injury prevention strategy, (b) source(s) of knowledge and (c) whether he/she incorporates it into training. It was found that athletes with access to an athletic trainer reported 17% more knowledge ( $p = 0.015$ ) and reported incorporating that knowledge into their training 33% more often ( $p = 0.003$ ). Several other statistics were analyzed using the demographic information to create several sub-populations. The majority showed no significant difference, but some data was found that shows the need for future research.

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I dedicate this work to my family, whose continual support allows me to take on any challenge that comes along with a poised confidence and eventual success. I would also like to thank the clinical staff at Pasadena City College and CSULB for all their help with the data collection process.

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## **CHAPTER 1**

### **INTRODUCTION**

Recreational sport participation has increased significantly in the last few decades across the country. Youth, high school, college and adult recreation have all grown in numbers and intensity (Randazo, Nelson, & McKenzie, 2010). Youth sports have allowed for increased specialization and higher levels of competition at a much younger age than ever seen before (Oller, Vairo, Sebastianelli, & Buckley, 2013). Though there are numerous benefits to increasing physical activity and exercise, there is also an associated increased risk of injury (Nelson, Collins, Yard, Fields, & Comstock, 2007). Currently, there are over 7 million high school level athletes in the United States- roughly half of all high school students (Swenson, Henke, Collins, Fields, & Comstock, 2012). There are an estimated 4.3 million sports related injuries occurring annually, 2 million of which are high school athletes (Randazo et al., 2010). The annual estimated direct cost to the health care system of these injuries is \$588 million (McGuine, 2006). The rising number of high school students participating in athletics is a trend that does not appear to be slowing down anytime soon. Therefore research is needed to identify how we can best care for athletes and keep them healthy.

Increase in participation numbers means an increase in the number of injuries especially when athletes begin participating at a younger age. An increase in participation in youth leagues and year-round teams allows for earlier specialization and the repetitive motions may be putting stress on the still developing musculoskeletal system (Kerr, Roos, Schmidt, & Marshall, 2013). In addition, athletes with more experience tend to have a greater risk of injury (McGuine, 2006). This may be attributed to experienced players being more aggressive and getting more playing



time and therefore having more opportunity to be injured (McGuine, 2006). Furthermore, early specialization may also lead to higher levels of competition at younger ages, putting more stress on the immature musculoskeletal system (Kerr et al., 2013). Even if these stresses do not immediately result in injury, early stress may leave athletes predisposed to injuries later in their career (Swenson, Yard, Field, & Comstock, 2009).

There are many potential reasons for this increase in youth sport participation. An increase in awareness about the risk of childhood obesity and metabolic syndrome leading to type II diabetes has led to greater availability of these programs to encourage physical activity for children (McGuine, 2006) through public health initiatives such as Michelle Obama's Let's Move. In addition, there is also cultural shift in the country. With the rising cost of college tuition and competition for admissions, parents/guardians are always looking for something that will help make their child stand out on an application and hopefully get some scholarships. This idea of the modern day pressure-parent has many psychological implications on the motivations behind athletes and their attitude toward participation and injury (Hoyle & Leff, 1997; Kerr et al., 2013). These psychological factors are beyond the scope of this study, but still deserve acknowledgement.

### **Injuries in High School Athletics**

As previously mentioned, roughly half of all sport related injuries occur in high school athletes. The most common injury among high school athletes is a sprain and the most commonly sprained joint is the ankle, which constitutes about 25% of all reported injuries (Nelson et al., 2007). While most ankle sprains are minor and cause minimal loss of participation, more severe ones such as anterior tibio-fibular sprains can cause weeks of

restriction from practice and competition (Nelson et al., 2007). Muscle strains are the next most common injury, representing 13.3% of injuries (Swenson et al., 2009). Strains can vary in severity as well, depending both on how much damage has been done to the fibers and what muscles are involved (Swenson et al., 2009). In addition to being the second most common injury overall, muscle strains are the second most common recurrent injury (Swenson et al., 2009). Of the estimated 2 million annual sport related injuries in high school athletics, 10.5% are recurrent injuries. Six percent of all injuries require surgery, with the shoulder being the most common surgical injury (Swenson et al., 2009). These injuries result in 500,000 associated doctor visits and 30,000 hospitalizations annually (Borowski et al., 2008).

It is likely that these injury statistics are under-reported due to lack of medical coverage at high school sporting events (Darrow, Collins, Yards, & Comstock, 2009). For an injury to be included in such a statistic, it would have to be reported as occurring as a result of participation in a high school sport. However, the only way that can be achieved is if the injury is recorded by a medical professional associated with the school (i.e. a team physician or athletic trainer; Nelson et al., 2007). Even then there is no guarantee the injury would be reported to an athletic injury database (Yards et al., 2008). Should an athlete seek care from a personal physician, it is highly unlikely that the injury will be recorded as an athletic injury or reported to an athletic injury database.

### **Medical Care in High School Athletics**

Even with abundant evidence of injury statistics on the developing adolescent athletes, there is a lack of uniform policy regarding medical coverage for high school sports (Quandt, Mitten, & Black, 2009). At the collegiate level, the National Collegiate Athletics Association

(NCAA) has very strict requirements regarding the medical coverage for practice and competitions as well as pre-participation evaluations (PPE) to insure the athlete is healthy enough for athletics and identify any potential risk factors for injuries that may need to be addressed to reduce the risk of injury (Hootman, Dick, & Agel, 2007). In stark contrast to the NCAA policies, there is no uniform policy for high school athletics (Refer to Appendix A for the state by state policies). Policies differ from state to state, due to the fact that each state is free to design their own requirements for medical coverage, with a few exceptions (Aukerman, Aukerman, & Browning, 2006). It is a national rule that there be some type of PPE for first year athletes and there must be some type of emergency medical responder available at competitions for high risk contact sports- typically just football (Aukerman et al., 2006). Anything beyond this basic coverage is completely up to the school to decide unless state legislation says otherwise.

Emergency medical coverage for high risk sports can be provided by healthcare professionals such as Emergency Medical Technician (EMT), physical therapist or medical doctor (National Federation of State High School Associations [NFHS], 2016). Any of these professionals are highly qualified to handle an emergency situation such as a concussion or spinal cord injury, however, these catastrophic injuries are relatively rare occurrences. Boden, Tacchetti, Cantu, and O'Mueller (2007) reported 0.67 catastrophic injuries per 100,000 in high school football. The common types of injuries that are likely to occur at a sporting event are non-emergent orthopedic injuries (Nelson et al., 2007; Randazo et al., 2010; Borowski et al., 2008). Although it is important to have health care professionals on the sidelines in order to care for catastrophic injuries, having a medical professional that practices identifying and managing these relatively minor orthopedic injuries daily and can advise the coaches and athletes on the best

course of action is integral to the athletic health and performance of the athlete. Orthopedic injuries are not likely life threatening or medical emergencies but can greatly affect the athlete's participation and performance and can potentially become emergencies if left untreated. Athletic trainers are one of the few health care professionals who can work with both catastrophic injuries and orthopedic injury evaluations (Delforge & Behnke, 1999).

An athletic trainer (AT) is an allied health care professional who is certified and trained to practice in the medical field. To become a Certified Athletic Trainer, one must first complete a Commission on Accreditation of Athletic Training Education (CAATE) accredited clinical Athletic Training Program (AT Program). This is currently either a four year bachelor's degree or two year master's degree. Once the education program is completed, the candidate is eligible to sit for the Board of Certification (BOC) exam. Upon passing the exam and graduating with a bachelor's degree, the candidate is now a Certified Athletic Trainer. The AT Program degree has several requirements to assure that all candidates sitting for the exam have met at least the same minimum requirements; supervised clinical experiences, successful demonstration of all competencies and proficiencies and extensive coursework in basic and field specific sciences. After becoming certified, ATs must also complete continuing education units every year to maintain certification. This insures ATs are continually learning the most up to date techniques and incorporating the most relevant research into their practice (CAATE, 2016).

The focus of the profession is to prevent and treat orthopedic injuries as well as helping patients achieve peak physical performance regardless of injury status or pre-existing condition (Johnson, 2010). ATs are trained in quickly evaluating and identifying athletic injuries and also being able to identify more complex medical issues for referral. In addition to clinical skills, ATs

are also well educated on the importance of medical documentation and record keeping, which as mentioned previously is an important factor in being able to create quality research from injury databases.

Although the athletic training profession is governed by National Athletic Trainers Association [NATA], CAATE, BOC, and Research and Education Foundation (REF), individual states determine the requirements to practice as an AT. Some states, such as Florida and New Mexico, require a license to practice in the state in addition to the BOC certification (BOC, 2016). In contrast to that, California does not have any requirements to practice as an AT. As long as a person does not identify him/herself as a *Certified* Athletic Trainer, he/she may practice under the title “Athletic Trainer” (BOC, 2016).

An athlete’s experience with athletic healthcare can vary greatly depending on where he/she attends school. In the state of California, there is no requirement for high schools to have an AT on site (Feder, Frey, Sleight, Pendergraph, & Smallman, 2010; California Interscholastic Federatio [CIF] Sports Medicine Guidelines, 2016). In contrast, there are states such as Colorado and Florida that require secondary schools to have a certified AT on staff at least part-time (Colorado High School Athletic Association [CHSAA], 2016; Florida High School Athletic Association [FHSAA], 2016). This often leaves times when athletes are at their schools participating in sports without proper medical coverage. Instead, they have to be reliant on their coaches to modify activity when they are injured until the injury is resolved or they need to see a doctor.

The NCAA experience is a complete contrast to the high school athletic setting. There is access to a full staff of ATs who are there to not only help manage injuries but also available to

evaluate the potential risk factors for injury and implement strategies to mitigate those risk factors when possible. Most importantly, this is the uniform experience for all NCAA athletes. There are strict rules regarding accessibility to athletic care and coverage for games and practices that apply to any NCAA program (NCAA, 2013).

### **The Problem**

Discussion to this point has provided an image of high school athletics and how healthcare is managed at that level. There are apparent gaps in access to care, specifically access to preventive care. The reason most often cited for schools not having an AT on staff is cost (Aukerman et al., 2006). However, as previously mentioned, high school athletic injuries account for an estimated \$588 million in direct costs to the healthcare system. Now it becomes a question of whether spending money up front on early and preventive medical access or paying for emergency costs and doctor visits after injury is more cost effective. To examine this idea, we will turn to general healthcare studies.

Numerous studies have investigated Medicare coverage and the efficacy of the program especially since ObamaCare. Earlier access to healthcare allows for better access to knowledge about making healthy choices and early recognition of health issues allowing a person to be proactive with regards to his/her health (Alvarez-Bueno, Rodriguez-Martin, Garcia-Ortiz, Gomez-Marcos, & Martinez-Vizcaino, 2014). It takes 2 years of continuous access to Medicare for the health status of a person who did not have health insurance before becoming Medicare eligible to reach the same health status as their comparable counterpart who had private insurance before Medicare (Baker et al., 2006). This increase in health status refers to both a self reported health status as well as measurements of mobility, and incidence of illness (Baker et al.,

2006) The key factor in the advantage of having earlier access to healthcare is the opportunity for education on health status, risk factors and lifestyle changes a person can make to be healthier (Bassi et al., 2014). Following the same logic found in the Medicare studies discussed thus far, it is reasonable to suspect that access to an AT in high school could increase an athlete's knowledge and/or implementation of injury prevention strategies. For the purposes of this study and injury prevention strategy will refer to any behavior that positively affects modifiable risk factor. Therefore, athletes with earlier access to healthcare via an AT at their school may have a higher health status (or better injury status) than those without due to the increased knowledge. Therefore, it is reasonable to suspect that access to an AT in high school has the potential to both increase athletic health status and decrease the overall cost to the healthcare system.

### **The Purpose**

The goal of this study is to use the same principles discovered in Medicare research and apply it to the athletic population in order to provide a groundwork that will help direct future studies. As mentioned above, educating subjects on risk factors and healthy lifestyle choices has been shown to increase health status (Alvarez-Buen, et al., 2014; Baker et al., 2006; Bassi et al., 2014). If the same principles were applied to athletic health, this would mean educating on risk factors for specific injuries and injury prevention strategies would potentially increase athlete's health status, resulting in a decreased injury risk. This study utilized a survey to investigate if any patterns in reported behavior and/or knowledge that would support this theory could be identified. The primary research question set out to be answered was, "Do athletic trainers have a positive impact on high school athletes' knowledge of injury prevention and training habits?" In addition to this main objective, several secondary research questions were also established: (a)

Does sport type have an effect on knowledge and/or implementation? b) Is there a difference in source for information between groups? (c) Is there a difference in knowledge of a specific injury prevention strategy between groups? (d) Does previous injury have an effect on knowledge and/or implementation? (e) Do athletes have an accurate understanding of their schools' AT status? (f) How does access to ATs vary between public versus private schools?

### **Definition of Terms**

The following is a list of technical terms used in this thesis. In order to aid the reader, this section will provide definition for these terms.

*Athletic health:* An athlete's health has more to it than their general health status. In this thesis athletic health also includes strength, cardiovascular endurance, joint health and any other factor that has an impact on an athlete's ability to perform the required skills for sport.

*Athletic trainer (AT):* As an allied health profession recognized by the American Medical Association, ATs work with physicians to provide preventive care, emergency response, clinical evaluation and rehabilitation to the athletic population.

*Athletic training program (AT program):* Before becoming eligible for certification, one must complete an accredited AT program. This is a four year bachelor's degree that includes a number of basic and field specific sciences as well as clinical experiences.

*Board of Certification (BOC):* The BOC for athletic training is an organization that provides the examination to determine if a candidate is competent to be licensed to practice as an AT. This insures that every Certified Athletic Trainer has at least the same basic skills.

*Commission on Accreditation of Athletic Training Education (CAATE):* This organization sets the bar for an AT program. When a school wants to start a program, it must demonstrate how



it will fulfill all the requirements set by CAATE for coursework and clinical experiences by applying for accreditation. If the school does not pass for accreditation, their graduates will not be eligible for licensure.

*Incorporation rate:* In this study, the incorporation rate refers to the amount of knowledge a participant reported is actually applied into their practice. It is the amount of reported application into practice divided by the amount of reported knowledge.

*Injury prevention strategy:* For the purposes of this study, an injury prevention strategy is defined as an studied intervention that positively affects a modifiable risk factor in an effort to decrease risk of injury.

*Knowledge rate:* For the purposes of this study, the knowledge rate refers to the amount of knowledge a participant reported having. It is the number of times a participant reported knowledge divided by the number of questions a participant was asked.

*Modifiable risk factor:* A risk factor is a condition that leaves a person more likely to get injured, including genetics, strength variance, neuromotor factors, hormonal changes, and so on. In this study, a modifiable risk factor is defined as a risk factor that can be reduced through behavioral changes, such as specific exercises or change in diet.

*National Athletic Trainers' Association (NATA):* The NATA is an organization of ATs whose mission is to represent, engage and foster the continued growth and development of the athletic training profession and ATs as unique health care providers.

*Pre-participation physical exam (PPE):* Prior to participation in high school sport an athlete must go through a PPE. This exam is designed to determine if a person is healthy enough for athletics. The exact parameters for a PPE vary from organization to organization.

## **CHAPTER 2**

### **LITERATURE REVIEW**

In this section, current literature will be presented to provide a sound basis for the principles used to design this study. The purpose of this study was to assess whether ATs have a positive effect on athletes' knowledge and implementation of injury prevention strategies. The first step in addressing this idea was providing a picture of the current state of high school athletics, including the epidemiology of injuries and current medical coverage. Current medical coverage can vary greatly because of the variance in state policy. The next section will discuss the differences in policy state to state and how that affects athletes. Once the reader has an image of high school athletics overall and some of the state to state differences, the next subject this literature review will address is the profession of athletic training, including the scope of practice and the qualifications required to become certified. Finally, the piece that links these all together and ties it all back to the original research questions is the research on Medicare and early access healthcare studies that show an increase in perceived and measured health status when there is earlier access to care. The compilation of research on these topics will provide evidence to support this study design.

#### **High School Athletics**

There is ample research on the epidemiology of injuries among high school athletes (Darrow et al., 2009; McGuine, 2006; Nelson et al., 2007; Randazo et al., 2010; Swenson et al., 2009). Most of this research focuses on the common injuries of a specific sport. While this information is valuable, there are also a number of gaps. The most prevalent issue epidemiology studies have is that they rely heavily on injury reporting databases. These databases are biased

and are not a true image of injury rates because they are almost exclusively maintained by ATs and sports medicine personnel at high schools and not all schools have AT on campus (Nelson et al., 2007). This means that athletes at high schools that do not have access to medical staff at their school are most likely excluded from the population data used in these epidemiology studies.

The alternative to database reliant studies is to form a team of researchers to personally observe and record injuries over a given amount of time for a group of athletes (Nelson et al., 2007). The limitations to this type of research include man-power, data collection time, and limited subject pool. This method of research can take years to gather data and thousands of hours of man-power to assess and record all the injuries, while a database study can provide decades worth of data for thousands of subjects almost instantly. There is value in both forms of research and at the present time, these are the only options for epidemiological data. As long as both forms of data are taken at face value and the limitations are acknowledged, the data provides a valuable groundwork for this study.

The Centers for Disease Control (CDC) estimates 4.3 million sports and recreation related injuries per year (Randazo et al., 2010) with 15-19 year olds accounting for half of those injuries. This age group also has the highest incidence rate of 9.3 injuries per 1,000 athletes (Randazo et al., 2010). The most common injury in high school athletics is the ankle sprain, accounting for an estimated 25% of all reported injuries (Nelson,et al., 2007). Strains account for 13.3%, fractures 9.9% and concussions 11.6%. Ten percent of all injuries are recurrent injuries (Swenson et al., 2009). Forty-five percent of shoulder surgeries are the result of recurrent injury (Swenson et al., 2009). Recurrent injuries result in more time loss, are more likely to require

surgery and are 3 times more likely to be career ending (Swenson et al., 2009). Emery Meeuwisse, & Hartman (2005) reported soccer players are 74% more likely to suffer a second injury once injured. McGuine (2006) reported that football players are 5 times more likely to have a second concussion once they have had a first.

The importance of focusing on the increased risk associated with a recurrent injury is to encourage injury prevention strategies before an athlete is injured and to implore the importance of proper rehabilitation and not rush the return to play (Swenson et al., 2009). Junge, Rosch, Peterson Graf-Baumann & Dvorak (2002) found a 21% decrease in injury rates when athletes implemented a proper warm-up/cool-down protocol along with education of injury prevention and balance and strength training for the purpose of injury prevention (McGuine, 2006). Swenson et al. (2009) also stated that the established risk of re-injury with sprains and strains indicate there should be an emphasized focus on injury prevention training to stop the initial occurrence of injury in the first place.

Access to ATs could provide athletes with more opportunities to be introduced to these preventive interventions and proper rehabilitations. It would also help educate them on common injury risk factors and how that risk can be reduced. However, even in situations where an AT is available, access alone may not be sufficient to increase the knowledge base of athletes. For example, parents and athletes do not fully understand the scope of knowledge and skills ATs possess and may not seek out their services because they do not think they are qualified (Weitzel, Miller, Gionatta, & Newman, 2016). Weitzel et al. (2016) conducted a study assessing parents' interaction, experience and impression toward ATs. The parent impression of the AT is potentially more important than the athlete's attitude because the parent is the main decision

maker with relation to the athlete's health care. This study found that parents' impression and understanding of the scope of practice is directly related to their exposure to ATs. While 50% of parents overall see ATs as health professionals and 61% believe ATs are important in society, 62% report that they do not always trust their opinion (Weitzel et al., 2016). Parents that have had one or fewer interactions with an AT described their skills as mainly relating to immediate emergency care (Weitzel et al., 2016). This is likely because parents may only see an AT when they are running out on the field or court for an acute incident. However, parents with higher exposure to ATs acknowledge both the rehab and preventive skills. In this same respect, orthopedic physicians and athletics directors have a better understanding of an AT's scope of practice than a non-orthopedic physician or school principal. The lack of understanding and limited exposure to the athletic training profession is all the more highlighted by the fact that after completing the survey, parents were 57% more likely to send their child to an AT. This suggests that they had so little knowledge about ATs that simply being exposed to a survey that discussed specific qualifications and skills was enough to increase their likelihood to send their child an AT (Weitzel et al., 2016). Therefore, it is important that secondary schools that have access to an AT make sure athletes and parents are aware of their services and skills (Weitzel et al., 2016).

In addition to making sure parents and athletes are aware of the services available to them, there are a multitude of other factors that should be considered and implemented when designing the infrastructure for a high school athletics program. Almquist et al (2008) performed a comprehensive review to create a consensus statement that reflects the NATA's official stance on the appropriate medical care for high school athletes. According to the findings of this

committee, providing a safe sporting environment begins with creating a solid administrative system that includes a database for recording injuries and a network and protocol for referrals. A significant amount of these consensus points center around injury prevention through preventive screening and good safety practices. These simple precautions can remove many unnecessary risk of sports (Almquist et al., 2008). This statement also highlighted the importance of the availability of immediate evaluation and treatment during participation. There was a clear pattern in the literature that having some type of medical personnel reduced injuries and recovery time (Almquist et al., 2008). Access to medical personnel also allows for opportunity to educate athletes about the multifaceted aspects of athletic health, including education on proper nutrition and hydration as well as injury risk factors and prevention strategies (Almquist et al., 2008). Educating people on risk and how they can mitigate that risk has been shown to increase their overall health status (Korczak, Deitl, & Seinhauser, 2011).

One prime example of the positive effect of education in high school athletics is concussion. Concussions are a hot topic and are getting increased media coverage and stricter guidelines for return to play after a head trauma (McCroy et al., 2009). In both high school and NCAA football, if an athlete's helmet falls off during a play they are automatically out for the next play (NCAA, 2014; NFHS, 2016). Educating the risks of returning athletes to play before they are completely healed and the cumulative effect of multiple concussions, has made both parents and athletes more willing to report symptoms honestly and follow protocols (Gessel, Fields, Collins, Dick, & Comstock, 2007).

## **Athletic Care Between States**

Most states have some type of requirement for medical care for their athletes that the school must provide (Quandt et al., 2009). This ranges greatly from requiring an emergency first responder be in attendance during high risk competitions to requiring the school to have a designated sports medicine professional under at least part time employment available for all athletes (See Appendix A for complete list of State Handbooks). On one end of the spectrum, there are states like Colorado and Florida that require every secondary school with an athletics program to provide all athletes with access to an AT (CHSAA, 2016; FSHAA, 2016). On the other end of the spectrum is California, that requires only an emergency first responder for high contact sport competitions and no regulation regarding who can practice under the title of “athletic trainer” (BOC, 2016; CIF, 2016).

Even states that do not require an AT or other medical professional to be employed by the school recommend having one and discuss their value in association publications (See Appendix A). Most state associations that had a publicly accessible handbook on their website had a dedicated sports medicine section that recommended, if not required, sports medicine personnel on staff at every high school (See Appendix A). Many states, such as Connecticut, Georgia and Pennsylvania require medical coverage only at competitions but recommend schools have an AT available onsite (CIAC, 2016; GHSA, 2016; PIAA, 2016). New Mexico not only requires schools hire ATs, but also has a pre-athletic training education program available at high schools to prepare students for a career in the field (New Mexico Activities Association [NMAA], 2016). Florida and Colorado require medical personnel be available on-site at all practices and

competitions. Doctors, nurses, and physician's assistants are all acceptable personnel but ATs are specifically recommended (CHSAA, 2016; FHSAA, 2016).

As mentioned previously, the state of California does not hold a high standard for providing medical coverage in high schools. Feder et al. (2010) performed a survey study of California high schools and found that 62% of high schools report having at least part-time access to an AT, though only 56% report their AT is certified. Feder, et al. also reported that physicians cover 62% of home games and 2% of away games in California. The most alarming statistic is that 39% of California high schools reported not having a first aid kit available onsite and 4% not implementing a PPE, even though both are required by CIF by-laws (Feder et al., 2010). Without a first aid kit, coaches aren't prepared to provide care for something as small as a cut, let alone a serious injury. As previously mentioned, California is one extreme of the spectrum, but schools that do not have a first aid kit at practice or perform PPEs are disregarding the few rules that are even in place.

The need for better medical care for athletes is recognized by coaches as well. Aukerman, Aukerman and Browning (2006) found that 50% of North Carolina coaches surveyed said the school's coverage was inadequate. The reason most schools state for not having medical staff for athletes is the cost. However, it has been found that having an AT available actually decreases the overall cost of medical care (Feinglass et al., 2014). Feder et al. (2010) also stated that athletes attending schools that have regular access to ATs recover from injury more rapidly and efficiently, thus reducing the overall medical cost.



## **Athletic Training Profession**

ATs are licensed medical professionals that specialize in injury prevention, rehabilitation and helping athletes achieve their peak performance regardless of injury status or pre-existing condition (BOC, 2010). As a profession, ATs often act as a link between the sideline and the team doctor. Physicians specializing in sports medicine are an important branch of the MD professional hierarchy. They are consulted as part of the medical team creating the emergency action plans [EAP], PPE guidelines and concussion protocols, and the athletes typically see them during team physicals and severe injuries. The AT is the professional that is available onsite on a daily basis. They are the ones that will do the initial evaluation and implement the day to day rehab and treatment. The profession occupies an important gap in the health care of athletes, as athletes attending schools that do not have an AT do not use their physician to fill in the daily care, they simply do without (Carek, 1999).

Athletic training is a relatively young profession. Its roots begin in the 1950s with the National Athletic Trainer's Association (NATA) being founded in 1950 (Delforge & Behnke, 1999). The goal of the NATA was to promote the profession and provide guidelines for the qualifications to be an AT. The first curriculum for athletic training was established in 1959. This curriculum paralleled the physical therapy curriculum with the addition of some courses specific to the athletic training field because young professionals were encouraged to further their education by continuing for their physical therapy license as well in order to expand their opportunities (Delforge & Behnke, 1999). The curriculum also required a secondary-level teaching credential because of:

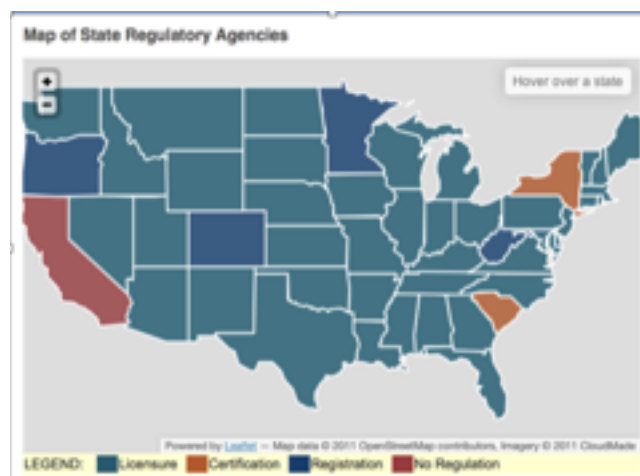
...a recognized need for employment of athletic trainers at the secondary school level, the curriculum was designed to prepare the student not only as an athletic trainer but also as a high school teacher, primarily in the areas of health or physical education. (Delforge & Behnke 1999, p. 54)

Even during the infancy of the profession, leaders in the NATA recognized the importance of ATs for high school aged athletes as a medical professional and an educator. For the first 17 years, the curriculum for an Athletic Training Education Program (ATEP) was not required to be its own major. It was typically an emphasis of a physical education major. It was not until 1986 that the NATA required the program to be a separate major. Then it was not until 1990 that the athletic training profession was recognized by the American Medical Association as an allied health profession. Today it requires a bachelor's degree, though the major is transitioning to a master's degree to be eligible for certification (CAATE, 2016).

The degree requirements to be eligible to sit for the BOC exam are set by a governing body called CAATE. As briefly mentioned before, there are specific standards that need to be in compliance for a program to be accredited. The standards include knowledge in basic sciences such as anatomy, physiology and kinesiology, as well as clinical experiences that provide opportunity for students to practice the clinical skills they learn in the classroom in real life situations with real athletes, under the supervision of a clinical preceptor. In order to insure minimum expected skills for an AT, the NATA provides a minimum standard of skills the entry-level AT should be proficient at in order to become certified (NATA , 2011).

While there are strict requirements to be eligible to become certified as an AT and the profession has been recognized as an allied health profession for over 20 years (Delforge, &

Behnke 1999), state policies vary greatly in their protection of the title and profession. The figure below shows the regulation level by state to practice as an AT. Licensure (also referred to as right-to-practice) is the most restrictive level of regulation. This means a person must first meet state determined requirements in order to legally perform the duties of athletic training within the scope of practice. Certification (also referred to as right-to-title) means a person can perform the duties of the profession, but may not use the title unless they have the certification. Registration means a person simply needs to be added to the state registry, usually for a nominal fee (BOC, 2013). In California, a person does not need to meet any qualifications to call him/herself an AT, as long as he/she does not claim to be a certified AT (BOC, 2016). This is important to because it demonstrates that the lack of uniform policy surrounding the athletic training profession in high school athletics is simply an example of the lack of uniform policy regarding the profession as a whole. High school athletic policies cannot be expected to be consistent between states when the legislation regarding protection of the profession in general varies so greatly between states. Licensure is required in 42 states, certification in 2 states, registration in 5 states and 1 states is unregulated.



**FIGURE 1. Map of state regulations.**

## **Early Access Medicare Studies**

Since Obamacare came into practice, there has been increased focus on conducting studies that assess the cost-effectiveness of early access healthcare and Medicare (Baker et al., 2006; Korczak, et al, 2011). On the surface, publicly funded healthcare seems like a financial burden to the government, when in actuality studies show that spending the moderate amount of money on early intervention and preventive care actually saves money in the long term (Musich, Klemes, Kuica, Wang, & Hawkins, 2014).

Feinglass et al. (2014) evaluated the efficacy of a free clinic for eligible uninsured residents in a suburb of Chicago. This study assessed health status, satisfaction and perceived quality of care in new patients ( $\leq 2$  weeks) with a follow-up assessment after being enrolled for at least 1 year in the program. The results showed a great improvement in health status. Eligibility for the clinic increased access to healthcare and perceived health status when the follow-up survey was compared to the baseline after being eligible for at least 1 year. This idea is also supported by Musich et al. (2014) and Baker et al. (2006), who both found that continuous access to healthcare increases health status and decreases the associated cost of maintaining that health status. These same researchers also reported that it takes 2 years of continuous Medicare coverage for a previously uninsured individual to reach the health status of an individual that was continuously insured (Baker et al., 2006).

There are two key factors that explain how early access to care may increase health status; educating people about healthy lifestyle choices and early identification of risk factors. For example, Bass et al. (1993) found that counseling to educate new parents on injury prevention in children increased positive behaviors and decreased accidental injury. In a similar

study, Alvarez-Bueno et al. (2014) found that counseling and educative intervention reduced alcohol consumption and related health risk in non-dependent subjects. Bassi et al. (2014) found that counseling and educating at-risk populations helped prevent metabolic syndrome. Musich et al. (2014) stated that most Medicare spending is on chronic disease. This study found that healthcare models that focus on prevention and wellness make for a better health status of individuals and a lower cost to the Medicare system by lowering emergency costs. Knowledge can go far in preventing illness and injury, but for the times it cannot prevent it, early identification and treatment is key. Unfortunately, uninsured individuals are less likely to seek out care until it is an emergency, at which point they become eligible for public insurance (Feinglass et al., 2014), leading to high emergency care cost to the Medicare system. Many parallels can be drawn between this general healthcare research and athletic health.

The inconsistency of medical coverage in high school athletics leaves many athletes with insufficient access to care during sport participation. This puts athletes at a potentially higher risk of injury. ATs have the education and clinical skills to educate athletes and coaches on injury risk factors and preventive interventions that could decrease their risk of injury. Since Medicare and early access healthcare studies show that early education on preventable and modifiable risk factors can increase health status and decrease the overall cost to the healthcare system, there is reason to support a parallel between these studies and athletic health. These principles supported in the literature form the basis of this study.

## **CHAPTER 3**

### **METHODS**

#### **Participants**

Participants in this study were incoming college freshmen athletes. To be eligible, the participant had to be an incoming freshman at least 18 years of age, graduated high school no earlier than the spring before they began attending college, a member of a high school sports team, is going to participate in an intercollegiate team and has not yet had any clinical interaction with the athletic training staff at the college. Participants were recruited from two schools. There were a total of 112 responses, four were excluded because they did not attend high school in the United States.

The participant pool consisted of 74 (68.5%) male and 34 (31.5%) female subjects. The participants were athletes from football, soccer, swimming, track and field, baseball, basketball, wrestling, volleyball, softball, water polo, and cross country. Fifty-seven (52.8%) subjects reported being multi-sport athletes (see table 1 for specific numbers for each sport). There was an average of  $5.9 \pm 4$  years of participation in sport with 16 years of experience being the maximum and 0 years being the minimum. Participants were separated into two groups based on whether they had an AT available at their high school (Group 1) or not (Group 2). Participants were also broken down into lower extremity sport athletes and upper extremity sport athletes based on the common injuries in the sport. Baseball, softball, water polo and swimming were considered upper extremity sports (19 participants) and track and field, cross country and football were considered lower extremity sports (72 participants). Sixty-four (59.3%) report at least one previous injury and 44 (40.7%) report no previous injury.

**TABLE 1. Sports by Subject**

Sport	Male	Female
Football	58	0
Soccer	18	17
Swimming	2	5
Track and Field	22	8
Baseball	4	0
Basketball	13	4
Wrestling	5	0
Volleyball	0	9
Softball	0	2
Waterpolo	0	6
Cross Country	4	3

### **Survey Methodology**

As this was a descriptive study, the survey used to collect data was created by the researcher specifically for this study. The survey consisted of a demographics section that asked: high school attended, sports played, years of participation, gender, athletic trainer status at their high school and previous injuries. The survey then consisted of eight question blocks for male participants and nine question blocks for female participants. Each question block examined the athletes' knowledge and/or implementation of that knowledge regarding a different injury with modifiable risk factors and was grouped into body segments. In order for the survey to create a general overview of the entire body, the body was broken up into segments, upper limb, lower limb, trunk and head. Once the body segments were defined, 1-2 injuries with modifiable risk factors were selected to create the survey; anterior cruciate ligament (ACL) injury, patellofemoral pain syndrome (PFPS), rotator cuff injury, scapular stability, low back pain and

concussion. Each question block followed the same format:

a. Are you aware of this risk factor for injury?

Yes

No (if no, skip to question X)

b. Where did you learn this from? (Select all that apply)

Doctor

Coach

Parents

Internet

Teammates

Athletic Trainer

Physical Therapist

c. Do you incorporate this knowledge into practice specifically for the purpose of injury prevention, not just fitness and strength?

Yes

No

The survey was validated by a panel of experts. Expertise was defined as having 10+ years in the field of athletic training. This panel consisted of two faculty from Cal State Long Beach, both ATCs and professors and two faculty from Ithaca College, also both ATCs and professors. A description of the study was given to each member of the panel along with the survey and edits were made based on suggestions by the panel until this final survey draft was created.



## Survey Design

Each question was chosen to highlight a specific injury with modifiable risk factors. These modifiable risk factors have been studied and proven to reduce injury occurrence. Literature support and justification for the selection of each of the injuries included in the survey will be provided in the section below.

**Did you know hamstring strength (the muscles in the back of your thigh) is a factor in ACL injury?** There have been many studies showing the association between the quads:hamstrings strength ratio and ACL injuries (Griffin, Althom, & Arendt 2006). Many coaches are beginning to include eccentric hamstring exercises such as nordic hamstring curls in their warm up to help reduce the athletes' risk of ACL injury in sports where ACL tears are common like soccer and basketball (Borowski et al., 2008). In a review by Griffin et al. (2006), it was found that while there are a multitude of factors that contribute to ACL injury such as individual anatomy and biomechanics, hormonal changes, sport, and neuromuscular factors, strengthening co-contracting muscles such as the hamstrings can decrease the chance of ACL injury, especially non-contact injuries. This same study found only two published programs that did not reduce knee injury. If knowledge of the affect of hamstring strength on ACL injuries leads to incorporation of hamstring strengthening for ACL injury prevention, then there is a reduced risk of injury to the ACL.

**Did you know rotator cuff weakness is associated with shoulder injuries especially in overhead athletes?** The overhead or throwing athlete can put an extreme amount of force through the shoulder complex (Borsa, Laudner, & Sauers, 2008). The shoulder is a unique joint in the extreme range of motion it can achieve in all planes, however this mobility comes with an

inherent instability (Will et al., 2009). Unlike the hip's deep, stable ball and socket design which can also move in all three planes and circumduction, the glenohumeral joint is very shallow and is often compared to a seal balancing a beachball on its nose. Only about 1/3 of the humeral head is in contact with the glenoid at any time (Will et al., 2009). This inherent structural instability is compensated for with muscular stability, specifically the rotator cuff muscles (Armfield, Sickel, Robertson, Towers, & Debski, 2003). These muscles work to keep the humerus depressed as far into the glenoid as possible through force couples with the larger muscles (Will et al., 2009). Weakness in the rotator cuff can lead to impingement and tendinitis due to poor biomechanics (Borsa et al., 2008).

**Did you know quadriceps weakness (the muscles in the front of your thigh) can contribute to patellofemoral pain syndrome (pain in the front of your knee joint)?**

Patellofemoral pain syndrome (PFPS) is one of the most common overuse injuries in sport, also commonly referred to as “jumper’s knee.” There are a multitude of anatomical and neuromuscular factors contributing to this ailment, malalignment of the patella, strength discrepancy between lateral and medial quads, increased Q-angle, attachment of the patellar tendon, arch pathologies in the foot- the list goes on and on (Waryasz, & McDermott, 2008). One factor that seems to be an issue in most cases is weakness in the quads, specifically the vastus medialis oblique (VMO). Neuromotor control plays a large role in this discrepancy. Often when a person contracts their quad, the majority of the voluntary contraction is from the vastus lateralis causing the patella to be tilted or pulled more to the lateral aspect of the patellar groove. Incorporating quad strengthening exercises that emphasize the VMO can prevent this discrepancy from developing and reduce the risk of injury (LaBotz, 2004).

**Did you know hip weakness can contribute to patellofemoral pain syndrome (pain in the front of your knee joint)?** As previously mentioned, PFPS is a multifaceted syndrome that has many contributing factors. The causes can be found up and down the kinetic chain. Weakness in hip musculature, specifically the gluteus medius can create exaggerated Q-angles and contribute to PFPS (Waryasz, & McDermott, 2008). This weakness can affect both static and dynamic alignment of the knee. This instability caused by the malalignment can increase the joint reaction force on the knee or contribute to patellar tracking issues (Powers, 2010). The hip provides a stable proximal attachment that should allow the lower limb to provide rigid support as the stance limb and mobile strength during gait or other sport skills. Weakness in the musculature of the hip can be detrimental to that leading to an increased risk of injury (Earl, & Hoch, 2011). Proper and balanced hip strengthening can prevent these imbalances from occurring and reduce the risk of injury (Dolak et al., 2011).

**Did you know scapular stability (stability of your shoulder blade) is a factor in preventing shoulder injury?** The shoulder girdle is the complicated interaction of the two true and one pseudo joints that create the mobility and strength of the upper limb. The only true articulation to the trunk for the entire limb is at the sternoclavicular joint, which is not a very substantial attachment for such a long lever (Kibler, 1998). The scapulothoracic attachment is not a true joint, but provides the stable base the limb needs to be moved through space with any kind of control (Kibler, 1998). Scapulohumeral rhythm allows for increased stabilization for this extremely mobile joint through the end ranges of motion. Rotating, tipping and winging allow the glenoid to move with the limb to increase contact at the articular surface. Without this stable

base and reliable scapulohumeral rhythm, the joint would be unstable at the end ranges of motion and leave the athlete susceptible to injury (DePalma, & Johnson, 2003).

**Did you know a lack of flexibility in the hips can contribute to low back pain?** The main hip flexor is the iliopsoas group, which originates on the ilium and lumbar vertebra and inserts on the lesser trochanter (Barr et al., 2005). Under normal circumstances, the resting length of the iliopsoas allows the lumbar spine to rest in the neutral position, maintaining optimal lordotic curve. However, tightness in the hip flexors causes the hips to rest in a slightly flexed position with a forward pelvic tilt, leading to an increased lordosis in the lumbar spine (Nadler, Malanga, DePrince, Stitik, & Feinberg, 2000). This is similar to keeping the spine in an extended position, which puts compression stress on the posterior elements and tension stress on the anterior elements of the spine (Purcell, & Micheli, 2009). Repetitive hyperextension or chronic low range extension can cause a number of spinal alignment issues that lead to chronic low back pain (Purcell, & Micheli, 2009). Correction of this lack of flexibility can decrease the risk of injury.

**Did you know female athletes have a greater risk of ACL injury than male athletes?** **(Females only).** Female athletes injure their ACL three to five times as often as their male counterpart (Griffin et al., 2006). There are several different reasons believed to contribute to the discrepancy, neuromuscular control differences, anatomical differences, biomechanical and size differences as well as hormonal differences. There is a slight increase in laxity of ligaments associated with certain points in the menstrual cycle (Lephart, Abt, & Ferris, 2019). Solingard et al. (2008) performed a randomized control study to test a warm up program specifically designed for female athletes to prevent severe knee injuries and found that the high compliance group

(subjects that attended the most practices and completed the most intervention sessions) had a significantly lower risk of injury.

**Did you know abdominal strength and core stability can reduce low back pain?** The spine is a long and very mobile segment of the body, as with any other structure, increased mobility inherently means decreased structural stability that must be compensated for with active stabilization from the surrounding musculature. Many factors in low back pain relate back to pathomechanics that cause the spinal segments to come out of alignment (Purcell & Micheli, 2009). The abdominals, specifically the transverse abdominus increase interabdominal pressure, which helps increase spinal stability. Weakness in the abdominal muscles puts the strain on the larger muscles of the back for stability, leading to muscle strains, malalignments and even disc injuries. Having strong abdominals creates a more rigid segment through the entire trunk and just like every other body segment discussed thus far, a stable base is key in preventing injury during dynamic movements (Barr, et al., 2005).

**Did you know concussion symptoms and recovery can vary greatly from person to person?**

Concussions have gotten increased media attention in the past few years with more and more professional athletes missing multiple games or even retiring early because of concussions, and the willingness to speak out about the dangers of second impact syndrome (SIS) from athletes like Cody Lehe and other SIS survivors. The most difficult aspect of concussions from a clinical stand point is the variety of symptoms and recovery time between athletes (Guskweicz et al., 2004). Rule changes in contact sports such as outlawing spearing and stricter helmet regulations are a step in the right direction in preventing concussions, but the greatest concussion risk is the

return to play. The guidelines used for return to play after a concussion are very generalized symptom scales and memory and balance tests (Heck, Clark, Peterson, Torg, & Weis, 2004). The balancing ability of a linebacker will vary greatly from a gymnast, though they may both score 100% on the balance portion of the return to play test. The much more accurate and personalized return to play guideline is to compare the athlete to their own baseline, meaning that prior to the start of the season athletes should be administered an IMPACT or BESS test so there is some baseline reference specific to that athlete (McCroy et al., 2009). While baseline testing does not prevent concussions, it can prevent catastrophic re-injury by preventing the athlete from returning to play before he/she is completely healed.

### **Consent Procedures and Data Collection**

CSULB IRB approval was obtained for the procedure of this study. Facility approval was obtained from participating colleges prior to data collection. The researcher contacted each facility with a description of the study and obtained a signed approval letter to distribute surveys during the fall sport pre-participation examination (PPE). At the beginning of the PPE, the researcher provided a description of the study and participation requirements to the athletes. Athletes were allowed to ask questions regarding the procedure. After all questions had been answered, consent forms and surveys were passed out. At that point, the coaches/ATs and the researcher stepped out to allow the athletes to complete the survey. Athletes that wanted to participate signed a consent form acknowledging their rights as a participant and that their results may be used for the purposes of this study. After all participants completed their surveys, consent forms and surveys were collected in two separate sealed drop boxes to insure there were no identifying markers on the survey. Athletes that decided not to participate simply returned their

blank survey and consent form to the sealed drop boxes as if they had filled them out. Once all surveys had been collected, the participants continued with their physical exam.

### **Statistical Analysis**

Results were analyzed using t-tests and chi-square tests to determine statistical significance in Excel. Though there were several factors being analyzed, each outcome was only being compared once between the two groups and was not correlated to other outcomes, so a t-test was sufficient. Results were analyzed in three ways. Individual subject data was used to assess the percent of knowledge the athlete had overall (number of knowledge questions answered yes  $\div$  number of questions answered) and the rate at which the athlete applied that knowledge into training (number of incorporation questions answered yes  $\div$  number of knowledge questions answered yes). This gave a knowledge and application rate for each subject. These rates were compared between athletes that reported access to an AT at their high school (Group 1) and athletes that did not (Group 2). A two-tailed, unequal pairs t-test was used to calculate significance with a  $p < 0.05$ . This was the main objective of this study: to determine if there is a difference between knowledge of injury prevention strategies and/or application of the se strategies in practice between high school athletes with and without access to an AT. In addition to this, several secondary objectives were analyzed from the demographic information.

Several sub-populations were analyzed as well. Subjects were separated into different sport groups based on the type of sport- upper extremity and lower extremity- to see if there was a relationship between common injuries in the subjects' sport and their knowledge of injury prevention strategies for those injuries. Rates reported for these relationships were compared using a chi-square test (chi-square critical value = 3.84). The number of athletes that were aware

of the injury prevention strategy in the sub-population was compared to the number with knowledge in the general population. Source of knowledge was also examined. A chi-square test was used to determine if athletes in Group 1 cited a source more often than those in Group 2. Chi-square test was also used to determine if there was a difference between Group 1 and Group 2 within the same question. Finally a t-test was used to determine if there was a difference in knowledge and implementation rate between athletes that reported a previous injury and those that reported no previous injury.



## **CHAPTER 4**

### **RESULTS**

Seventy-five participants reported having access to an AT at their school, 66 (88%) of which reported knowing their AT was certified and 9 (12%) were unsure. Twenty-five (23.1%) participants reported no access and eight (7.4%) were unsure. It was then verified by the researcher through compiling a list of high schools the participants reported attending and determining if the school had an AT on staff, that four of the subjects that were unsure actually did have an AT available at their school and three athletes that reported having access to an AT did not have one available at their school.

#### **Primary Outcome**

The knowledge rate for a subject was calculated by dividing the total number of knowledge questions answered yes by the number of questions answered (8 for males and 9 for females). A t-test comparing the average rate between groups showed athletes that reported having access to an AT in high school reported an average of 17% more knowledge of injury prevention and risk factors than their counterparts with no access with a  $p = 0.015$ . They also reported incorporating that knowledge into their training 33% more often than participants in Group 2 with a  $p = 0.003$  (See Table 2). Incorporation rate was calculated by taking the number of knowledge questions the participant responded yes to and dividing that into the number of incorporation questions responded yes to.

**TABLE 2. *t* Test for Knowledge and Implementation Rates Between Groups**

	Group 1	Group 2	T-test p value (T-critical)
Knowledge Rate	45% $\pm$ 27.2%	28% $\pm$ 30.1%	0.015 (2.03)
Implementation Rate	66.8% $\pm$ 40.3%	36.1% $\pm$ 43.1%	0.003 (2.02)

**Is There a Difference in Knowledge of a Specific Injury Prevention Strategy Between Groups?**

Chi-square tests were used to compare groups within the same question. There was no statistically significant difference knowledge of any one injury prevention strategy between Group 1 and Group 2 except for concussion risk. Participants in Group 1 reported 41.9% more knowledge and incorporated that knowledge into practice 55.2% more often with a  $p < 0.00$ . There was also nearly significant difference in knowledge of rotator cuff weakness and shoulder pain between groups ( $p = 0.06$ ), which may be significant in a larger, more balanced test population (See Table 3).

**Does Previous Injury Have an Effect on Knowledge and/or Implementation?**

A t-test revealed there was no significant difference found in knowledge or implementation between subjects with reported previous injuries and those without.

**Does Sport Type Have an Effect on Knowledge and Implementation?**

There was also no statistically significant difference between the type of athlete and knowledge of common injuries in that sport. Upper extremity and lower extremity athletes had no more knowledge on upper or lower extremity injuries, respectively, than the average athlete (See Table 4).

**Is There a Difference Between Groups and Source of Information?**

AT was cited as one of the sources of information in 23% of responses, second only to coach, which was cited in 25.9% of responses (See Table 5). A chi-square test revealed that

athletes in Group 1 cited their coach as a source 24.5% more often than athletes in Group 2 with a  $p < 0.000$ . There was no statistically significant difference between groups with any other source (See Table 6).

### **Do Athletes Have an Accurate Understanding of Their Schools' Athletic Trainer Status?**

Four of the subjects that reported not having access to an AT at their high school actually did have one on staff at their school. Three of the subjects that reported having access to an AT at their high school did not have one on staff at their school.

### **How Does Access to Athletic Trainers Vary Between Public Versus Private Schools?**

Participants reported attending a wide variety of high schools. In total there were 70 different schools reported, 59 (84.3%) public schools, 7 (10%) private schools and 4 (5.7%) charter schools. Public school athletes made up 85.4% of the population, private school athletes 9.3% and charter school athletes 5.2%. Forty-four (74.6%) of the public schools had access to an AT, 15 (25.4%) did not. Six (85.7%) of the private schools had access to an AT, one (14.3%) did not. Only one charter school (25%) had access to an athletic and three (75%) did not. No statistical analysis was performed to try to determine significance because there were insufficient numbers to give power to the calculations.

**TABLE 3. Comparison Between Groups for Each Question Block**

Question Blocks	Knowledge Rate Group 1	Knowledge Rate Group 2	Chi Square Test p-value	Implementation Rate Group 1	Implementation Rate Group 2	Chi Square Test p-value
1) ACL injury	52%	40%	0.299	66.7%	70%	0.841
2) rotator cuff	58.7%	28%	0.06	43.2%	57.1%	0.491
3) PFPS quad weakness	37.8%	20%	0.102	82.1%	60%	0.265
4) PFPS hip weakness	37.8%	20%	0.102	57.1%	80%	0.335
5) scapular stability	29.7%	12%	0.078	72.7%	66.7%	0.826
6) hip flex LBP	58.7%	48%	0.352	81.8%	66.7%	0.257
7) Female ACL	45%	37.5%	0.717	22.2%	66.7%	0.157
8) ab strength LBP	60.3%	48%	0.284	70.5%	91.7%	0.133
9) concussions	69.9%	28%	0.000	96.2%	42.9%	0.000

**TABLE 4. Insignificant Results**

Previous Injury Status	Knowledge Rate	Implementation Rate
Previously Injured	43.8%	61%
No Previous Injury	37.4%	51.9%
T-critical	1.98	1.99
T-test p value	0.265	0.275

Sport Type	Knowledge Rate of Sport Specific Injury Prevention Strategies	Implementation Rate of Sport Specific Injury Prevention Strategies
Upper Extremity Athlete	56.3%	29.2%
Non Upper Extremity Athlete	36.5%	27.1%
T-critical	2.12	2.13
T-test p value	0.203	0.853
Lower Extremity Athlete	38.5%	45.1%
Non Lower Extremity Athlete	36.7%	28.2%
T-critical	1.98	1.98
T-test p value	0.812	0.06

**TABLE 5. Sources for Information**

Source	# of Citings	Rate
Doctor	157	20.9%
Coach	195	25.9%
Parents	78	10.4%
Internet	82	10.9%
Teammates	67	8.9%
ATC	173	23%
PT	84	11.2%

**TABLE 6. Comparison of Source for Information Between Groups**

	Group 1	Group 2	Chi-square test p-value
Rate Coach was cited as a Source of Knowledge	49.8%	25.4%	< 0.000
Rate Doctor was cited as a Source of Knowledge	16.8%	28.4%	0.11
Rate PT was cited as a Source of Knowledge	9.2%	13.7%	0.57
Rate Internet was cited as a Source of Knowledge	9.7%	8.6%	0.87
Rate Parents was cited as a Source of Knowledge	9.1%	9.5%	0.91
Rate Teammate was cited as a Source of Knowledge	7.7%	8.6%	0.87

## **CHAPTER 5**

### **DISCUSSION**

#### **Primary Objective**

The results from this study showed athletes that have access to an AT in high school reported more knowledge of injury prevention strategies and incorporated them into practice more than those without. Each of the injury risk factors discussed in the survey has proven protocols that can show a reduction in injuries per athlete exposure (Powers, 2010; Lephart et al., 2002; Armfield et al., 2003; McCroy et al., 2009; Dolak et al., 2011; Barr et al., 2005).

Therefore, increased awareness and incorporation of these strategies has the potential to reduce injuries. This finding is consistent with the early access health studies discussed in chapter 2. Earlier access to healthcare increases people's knowledge of healthy habits and the likelihood that they will incorporate that knowledge into their daily lives, and therefore would be less likely to suffer a severe injury, ultimately lowering the cost to the healthcare system (Musich et al., 2014; Korczak et al., 2011).

The principles of the findings in the previously discussed Medicare literature support the findings of this study, specifically the AT's effect on high school athletes' knowledge of injury prevention. The parallel between early access Medicare studies and access to an AT in high school lies in assessing if ATs increase knowledge of injury risk factors and preventive strategies. In previously discussed studies, earlier education of good habits and modifiable risk factors lead to healthier habits and increased health status (Musich et al., 2014; Korczak et al., 2011; Bass, et al., 1993; Alvarez-Bueno et al., 2014). Based on this pattern in general healthcare, it is reasonable to suspect a similar pattern in athletic care; earlier access to an AT might lead to

healthier training habits and increased athletic health. Since it was confirmed by this study that athletes with access to an AT report greater knowledge and incorporation rates than those without, it is reasonable to suspect there is an increase in athletic health status amongst the same athletes.

### **Is There a Difference in Knowledge of a Specific Injury Prevention Strategy Between Groups?**

There was no difference in knowledge of any the injury prevention strategies between groups except for concussions. Nothing in the literature set an expectation one way or the other for this relationship. Medicare and early access health studies set the expectation that there should be an overall increase in reported knowledge and incorporation of injury prevention strategies (Musich et al., 2014; Korczak et al., 2011; Bass et al., 1993; Alvarez-Bueno et al., 2014), but there was no data to support or denounce if researchers should expect to see that increase in knowledge within each question. This study found no significance within a single injury prevention strategy except for concussions. However, the intervention athletes were asked about in the survey for concussions was IMPACT and BESS baseline testing and athletes do not typically have a choice of whether or not to complete the baseline tests, either the school implements them or not (McCroy et al., 2009). This might explain why there was such dramatic significance with this question between groups and none with any of the other questions. Group 1 participants were only slightly more knowledgeable about each individual factor than Group 2 participants but it only reached significance when overall knowledge was examined.

### **Does Previous Injury Have an Effect on Knowledge and/or Implementation?**

There was no significant difference in knowledge or implementation rates between athletes who had been previously injured and athletes who had no history of injury. This finding



is inconsistent with the literature. It was suspected that previously injured athletes would be more knowledgeable and more likely to implement that knowledge into practice because they would have learned about their increased risk of re-injury and strategies to prevent that during their recovery from injury. This would have been consistent with findings in Medicare and athletic studies that education provided by health professionals highlight the risk of re-injury and strategies to reduce that risk (Swenson et al., 2009; Musich et al., 2014; Korczak et al., 2011). The lack of relationship may be attributable to the fact that the most commonly reported injury was an ankle sprain and there were no questions about ankle injury risk factors. It is possible that there was an increase in knowledge but the survey did not assess that knowledge. Therefore further research is needed on the subject.

### **Does Sport Type Have an Effect on Knowledge and/or Implementation?**

There was no statistically significant relationship between sport type and common injuries in that sport. Upper extremity athletes reported no more knowledge or implementation of upper extremity injury prevention strategies than the general population, and the same was found for lower extremity athletes and lower extremity injuries. Although there was no research in the literature to investigate this relationship, it was suspected by the researcher that there would be greater knowledge of sport specific injuries within that population under the assumption that athletes would be taught about common injuries in their sport, the way previously injured athletes are educated on their increase of re-injury after initial injury (Swensen et al., 2009). However, it should be noted that once the subject pool was broken down into these sub-populations, the numbers did not meet conventional equations for minimum sample size. The

lack of statistical significance may be rooted in a lack of power. Further research is needed with larger sample sizes to truly confirm or denounce these relationships.

### **Is There a Difference Between Groups and Source for Information?**

The most profound piece of information revealed by this study was where athletes are gaining their knowledge. Athletes in Group 1 cited their coach as a source of information 24.5% more often than those in Group 2. This finding merits further research in determining if there is a significant correlative relationship between coaches' knowledge of injury risk factors and prevention strategies and their access to ATs. There was no statistically significant difference between groups for any other source.

ATs were cited as one of the sources for information 23% of the time. That put the AT as the second most cited source for information. The most cited source was coaches, cited 25.9% of the time. This shows ATs already occupy an important role in providing athletes with education on their athletic health, although coaches are cited as a source slightly more often than ATs. This could be in part due to the coach-athlete relationship, potentially making the coach an easier person for the athlete to talk to, or more likely because the coach is the most readily accessible person for the athlete to talk to (McGuine, 2006). This finding is somewhat consistent with the literature, in that where the information comes from and how credible that source is seen as is important in a person's utilization of that information (Weitzel et al., 2016; McGuine, 2006; Alvarez-Bueno et al., 2014).

Doctors were the next most commonly cited source at 20.9%. Parents and the internet each accounted for 10% of the sources for knowledge, teammates 8% and physical therapist the remaining 11%. It is important to recognize that some of these sources are not traditionally

credible sources. Unless someone's parent happens to be a physician or medical professional, there are no inherent qualifications that would make them knowledgeable about orthopedic injuries. This raises the issue of quality of information. Athletes with access to an AT reported incorporating their knowledge into practice 33% more often than those without. Not only are ATs providing more information, but it is potentially seen as higher quality information and therefore applied more often, a theory consistent with McGuine (2006).

When it comes to youth and high school sports, it is potentially more important to educate the coach on injury prevention strategies than the athlete. Having an educated coach has been shown to decrease injury occurrence as it has been found in some studies that injury rates are lower when athletes are coached by a college graduate (McGuine, 2006). The athlete does not need to know that performing a certain exercise during practice reduces their risk of injury in order to reap the benefits, he/she simply needs to do it consistently. The fact that coaches who have ATs available are cited as a knowledge source 24.5% more often supports the potential for an educational relationship between ATs and coaches. This study could be adapted and repeated assessing coaches' knowledge and incorporation of injury prevention strategies and their source for said knowledge.

### **Do Athletes Have an Accurate Understanding of Their Schools' Athletic Trainer Status?**

Of the 108 eligible subjects in this study, 69.4% report having access to an AT at their school, with 88% of those athletes knowing their AT was certified and 12% unsure. 23.1% report no access to an AT and 7% were unsure. Several of the participants' report of the AT status at their school were not consistent with the actual AT status of the school. There are many potential explanations for the discrepancy between subject responses and reality. Subjects that reported not

having an AT when there was one available at their school were probably just unaware of the services available to them because they were never informed or simply never had an introduction to the AT and the services they provide.

The athletes that erroneously reported having access to an AT could have potentially had access to one through their medical group or club athletics, since there are many sports clinics that utilize ATs. It is also possible that these subjects do not understand the distinction between AT and personal trainer and responded as having an AT because they had a personal trainer. The most concerning explanation is that because all of the subjects that incorrectly reported having access to an AT at their school attended high school in California, they may have mistaken non-certified people as Certified Athletic Trainers. As discussed previously, the athletic training title is not regulated in California, meaning anyone can call themselves an “athletic trainer” so long as they do not claim to be certified (BOC, 2016).

The information gained from these erroneous responses is the importance of education. When a school does provide access to an AT for their athletes, it is important that they make sure all students are aware of their presence and services. It is the responsibility of the AT to introduce him/herself as a “Certified Athletic Trainer” and emphasize the distinction between an AT and a personal trainer. As discussed by Weitzel et al. (2016), many people see ATs as an unreliable source of information until they have had an interaction with one because they do not understand the scope of practice and the amount of education and clinical experience that is required to obtain certification. Simply taking a survey that assessed parents’ knowledge of ATs’ scope of practice increased their knowledge of the profession enough to increase the likelihood of consulting with an AT for their child (Weitzel et al., 2016). Coaches, administrators and ATs need

to take responsibility for providing education to parents and athletes on utilizing the services available to them.

### **How Does Access to Athletic Trainers Vary Between Public Versus Private Schools?**

Athletes in public schools reported access to an AT at school less often than private school athletes and charter school athletes reported the least access. Although these numbers are purely descriptive. No statistical analysis was performed because there were not enough subjects in each group to achieve statistical power. The athletes attending private schools reported access to ATs 85.7% of the time while those at public schools only reported access 74.6% of the time. The purpose of analyzing this information was to establish a base that could help determine if there is reason to suspect a socioeconomic factor associated with access to athletic care similar to general healthcare. This pattern is similar to early access Medicare studies that discuss the variance in access to care between socioeconomic groups (Feinglass et al., 2014; Musich et al., 2014). People in lower income brackets typically rely on public health insurances and tend to have a lower health status than those who can afford consistent private insurance (Baker et al., 2006; Musich et al., 2014). This supports the need for future research into the socioeconomic differences in access to ATs. Based on the previously discussed literature, it is likely that unless it becomes required by law, athletes at higher socioeconomic schools will tend to have better access to ATs.

### **Limitations and Implications for Future Study**

While this study had a number of positive results, there were some limitations. The subject pool was disproportionately male due to the fact that the data collection was performed during the fall sport PPE, therefore football players made up a large portion of the population.

There was also an uneven distribution between groups that, even though the unequal distribution was accounted for when choosing statistics, may have affected the statistical analysis. In addition, though the sample size was large enough to reach significance for the primary objective, it may not have been large enough to allow for statistical analysis in the sub-populations. There may be statistical significance in the sub-populations that did not possess the power to reach  $p < 0.05$  due to sample size. The small sample size also limited the ability to perform ANOVA analyses to control for factors such as previous injury.

The fact that this survey was done on paper and required the researcher to personally attend PPEs made it difficult to reach as large of a population as originally desired. There was also a geographical bias. Even though the study was performed at a college, so there were out of state participants, the population was overwhelmingly from Southern California. This could have influenced the results significantly, as the state to state variance in policy has already been discussed (See Appendix A).

Many of the secondary outcomes show need for further research into those areas. Most notably was the increase in citing a coach as a source at schools with an AT. This study could be adapted to investigate coaches' knowledge, their incorporation of that knowledge and where they get their information from. Type of athlete knowledge of common injuries in that sport also nearly reached significance with lower extremity athletes and may prove significant in a larger subject pool. Finally, while previous injury status showed no significance with athletes' knowledge rate, the majority of reported previous injuries were not discussed on the survey, therefore there is still the potential for a relationship.

Given the opportunity to repeat this study with more time and resources, several modifications would be made. The study would utilize a focus group to better design the survey, as participants still asked for clarification on some questions during data collection. The focus group would help insure the questions are clear and as understandable as possible. The participants would be all active high school students. The demographics section would also be expanded to investigate frequency of interaction with AT, quality of interactions and whether the AT was full or part-time. Socioeconomic background would also be included to investigate if there is a socioeconomic factor in access to an AT. The study would also include a coaches' survey to assess coaches' knowledge, implementation and source for knowledge. All these additional factors are also contingent on taking as much time as would be needed to insure adequate numbers are reached to have statistical power even in the sub-populations.

### **Conclusion**

While there were limitations to this study, there is data to support the idea that ATs have a positive impact on high school athletes' knowledge of injury prevention strategies and training habits. Athletes with access to ATs reported more knowledge and incorporate that knowledge into training significantly more often than their counterparts at schools without ATs. The data also supports the idea that ATs may be an important role in indirect education of the athletes through education of coaches, as athletes in Group 1 cited their coach as a source of knowledge significantly more often than those in Group 2. The study was designed as a groundwork study to provide a platform to direct future study to promote the profession of athletic training and the important role ATs play in the health of young athletes. There was sufficient evidence to provide direction and support for future study of athletic healthcare in high school sports. The patterns

found in this study support the possibility that early access to athletic healthcare may parallel the same benefits found in early access Medicare studies in the general population. The next step in research is designing a method to quantify athletic health status in order to better study the potential impact ATs and other sports medicine professionals have on athletic health following the designs of Medicare studies. Increasing the available data on the subject may help provide the support for legislative and regulatory changes to provide athletes with more consistently available athletic care.



## **APPENDICES**

**APPENDIX A**

**STATE HIGH SCHOOL ASSOCIATION HANDBOOKS**

<b>State</b>	<b>Link to Handbook</b>	<b>Medical Coverage Requirements</b>
Alabama	<a href="http://www.ahsaa.com/AHSAA/Sports-Medicine-Safety">http://www.ahsaa.com/AHSAA/Sports-Medicine-Safety</a>	No information.
Alaska	<a href="http://asaa.org/handbook-forms/">http://asaa.org/handbook-forms/</a>	No requirements yet. Legislation in works.
Arizona	<a href="http://aiaonline.org/about/procedures-manual">http://aiaonline.org/about/procedures-manual</a>	Required at competition, strongly recommended AT is available at school.
Arkansas	<a href="http://members.ahsaa.org/public/userfiles/Admin/2015-16_AAA_Handbook.pdf">http://members.ahsaa.org/public/userfiles/Admin/2015-16_AAA_Handbook.pdf</a>	Coaches have required training.
California	<a href="http://www.cifstate.org/sports-medicine/handbook/Sports_Med_Handbook_March_30_2011.pdf">http://www.cifstate.org/sports-medicine/handbook/Sports_Med_Handbook_March_30_2011.pdf</a>	EMS at competitions only.
Colorado	<a href="http://www2.chsaa.org/sports/medicine/SPORTSMEDICINEHANDBOOK2016.pdf">http://www2.chsaa.org/sports/medicine/SPORTSMEDICINEHANDBOOK2016.pdf</a>	Required at all practices and competitions.
Connecticut	<a href="http://www.casciac.org/pdfs/ciachandbook_1617.pdf">http://www.casciac.org/pdfs/ciachandbook_1617.pdf</a>	Required at competition, strongly recommended AT is available at school.
Delaware	<a href="http://www.doe.k12.de.us/Page/1670">http://www.doe.k12.de.us/Page/1670</a>	No information.
Florida	<a href="https://www.fhsaa.org/sites/default/files/attachments/2010/09/16/node-235/1617_handbook_full_revised_0.pdf">https://www.fhsaa.org/sites/default/files/attachments/2010/09/16/node-235/1617_handbook_full_revised_0.pdf</a>	Required at all practices and competitions.
Georgia	<a href="http://www.ghsa.net/sites/default/files/documents/Constitution/Constitution2016-17Complete.pdf">http://www.ghsa.net/sites/default/files/documents/Constitution/Constitution2016-17Complete.pdf</a>	EMS at competitions only.
Hawaii	<a href="http://www.sportshigh.com">http://www.sportshigh.com</a>	School required to have access to medical personnel.
Idaho	<a href="http://idhsaa.org.live.phydostyle.com/manage/articlefiles/56-15-16%20Rules%20and%20Regs.pdf">http://idhsaa.org.live.phydostyle.com/manage/articlefiles/56-15-16%20Rules%20and%20Regs.pdf</a>	Medical personnel recommended.
Illinois	<a href="http://www.ihsa.org/documents/forms/current/IHSA_Policies.pdf">http://www.ihsa.org/documents/forms/current/IHSA_Policies.pdf</a>	AT highly recommended.
Indiana	<a href="http://www.ihsaa.org/Portals/0/ihsaa/documents/about%20ihsaa/2016-17%20By-Laws.pdf">http://www.ihsaa.org/Portals/0/ihsaa/documents/about%20ihsaa/2016-17%20By-Laws.pdf</a>	Unclear
Iowa	<a href="http://www.iahsaa.org/wp-content/uploads/2013/02/IHSAA-Handbook-2016-2017.pdf">http://www.iahsaa.org/wp-content/uploads/2013/02/IHSAA-Handbook-2016-2017.pdf</a>	Medical personnel recommended.
Kansas	could not locate	
Kentucky	<a href="http://khsaa.org/general/regulations-and-policies/handbook-2016-2017/">http://khsaa.org/general/regulations-and-policies/handbook-2016-2017/</a>	Unclear

<b>State</b>	<b>Link to Handbook</b>	<b>Medical Coverage Requirements</b>
Louisiana	<a href="http://www.lhsaa.org/handbook">http://www.lhsaa.org/handbook</a>	Medical personnel recommended.
Maine	<a href="http://www.sad55.org/athleticsweb/MPA%20Coaches%20Handbook.pdf">http://www.sad55.org/athleticsweb/MPA%20Coaches%20Handbook.pdf</a>	School required to have access to medical personnel.
Maryland	<a href="http://www.mpssaa.org/assets/1/6/Handbook_1617_web.pdf">http://www.mpssaa.org/assets/1/6/Handbook_1617_web.pdf</a>	No requirement.
Massachusetts	<a href="http://www.miaa.net/gen/miaa_generated_bin/documents/basic_module/MIAAHandbook1517.pdf">http://www.miaa.net/gen/miaa_generated_bin/documents/basic_module/MIAAHandbook1517.pdf</a>	AT required.
Michigan	<a href="http://www.mhsaa.com/schools/health-safety-resources">http://www.mhsaa.com/schools/health-safety-resources</a>	School required to have access to medical personnel.
Minnesota	<a href="http://mshsl.org/mshsl/Publications/code/handbook/HandbookTOC.htm?ne=8">http://mshsl.org/mshsl/Publications/code/handbook/HandbookTOC.htm?ne=8</a>	Medical personnel recommended.
Mississippi	<a href="http://www.misshsaa.com/wp-content/uploads/2016/07/2016-17-MHSAA-Handbook_s.pdf">http://www.misshsaa.com/wp-content/uploads/2016/07/2016-17-MHSAA-Handbook_s.pdf</a>	Medical personnel recommended.
Missouri	<a href="https://www.mshsaa.org/Search/?q=handbook">https://www.mshsaa.org/Search/?q=handbook</a> <a href="https://www.mshsaa.org/Search/?q=handbook">https://www.mshsaa.org/Search/?q=handbook</a>	Medical personnel required for competition.
Montana	<a href="http://assets.ngin.com/attachments/document/0088/8550/2016-17-By-Laws.pdf">http://assets.ngin.com/attachments/document/0088/8550/2016-17-By-Laws.pdf</a>	Unclear
Nebraska	<a href="http://nsaahome.org/sports-medicine/">http://nsaahome.org/sports-medicine/</a>	Unclear
Nevada	<a href="http://www.leg.state.nv.us/nac/nac-386.html">http://www.leg.state.nv.us/nac/nac-386.html</a>	AT required.
New Hampshire	<a href="http://nhiaa.org/PDFs/5510/5ByLawArticleIIISportsMedicine.pdf">http://nhiaa.org/PDFs/5510/5ByLawArticleIIISportsMedicine.pdf</a>	Required at all practices and competitions.
New Jersey	<a href="http://www.njsiaa.org/resources/njsiaa-handbook">http://www.njsiaa.org/resources/njsiaa-handbook</a>	No requirement. Recommended physician is reachable via phone.
New Mexico	<a href="http://www.nmact.org/nmaa-handbook">http://www.nmact.org/nmaa-handbook</a>	School required to have access to medical personnel.
New York	<a href="http://www.nysphsaa.org/SafetyResearch">http://www.nysphsaa.org/SafetyResearch</a>	Medical personnel recommended.
North Carolina	<a href="http://sbepolicy.dpi.state.nc.us/policies/HRS-D-000.asp?pri=03&amp;cat=D&amp;pol=000&amp;acr=HRS">http://sbepolicy.dpi.state.nc.us/policies/HRS-D-000.asp?pri=03&amp;cat=D&amp;pol=000&amp;acr=HRS</a>	Medical personnel required for competition. Recommended schools have ATC on staff.
North Dakota	<a href="http://www.ndhsaa.com/files/Constitution_and_ByLaws.pdf">http://www.ndhsaa.com/files/Constitution_and_ByLaws.pdf</a>	Medical personnel recommended.
Ohio	<a href="http://www.ohsaa.org/medicine/default.htm">http://www.ohsaa.org/medicine/default.htm</a>	AT required.
Oklahoma	<a href="http://www.ossaa.net/docs/2016-17/OSSAAInfo/MF_2016-17_OSSAARules.pdf">http://www.ossaa.net/docs/2016-17/OSSAAInfo/MF_2016-17_OSSAARules.pdf</a>	No requirement.
Oregon	<a href="http://www.osaa.org/governance/handbooks/osaa">http://www.osaa.org/governance/handbooks/osaa</a>	AT required.

<b>State</b>	<b>Link to Handbook</b>	<b>Medical Coverage Requirements</b>
Pennsylvania	<a href="http://www.piaa.org/assets/web/documents/Handbook%20-%20Section%20VI%20-%20Sports%20Medicine.PDF">http://www.piaa.org/assets/web/documents/Handbook%20-%20Section%20VI%20-%20Sports%20Medicine.PDF</a>	Medical personnel required for competition/practice for contact sports. ATC recommended.
Rhode Island	<a href="http://www.riil.org/files/5814/7249/2866/ARTICLE_34_2016MEDICAL_POSITION_STATEMENTS.pdf">http://www.riil.org/files/5814/7249/2866/ARTICLE_34_2016MEDICAL_POSITION_STATEMENTS.pdf</a>	Medical personnel required for some sports.
South Carolina	<a href="http://www.schsl.org/2016Forms/HBbylaws16-17.pdf">http://www.schsl.org/2016Forms/HBbylaws16-17.pdf</a>	No requirement.
South Dakota	<a href="http://www.sdhsaa.com/Athletics/AthleticHandbook.aspx">http://www.sdhsaa.com/Athletics/AthleticHandbook.aspx</a>	No information.
Tennessee	<a href="http://tssaa.org/tssaa-bylaws-constitution/">http://tssaa.org/tssaa-bylaws-constitution/</a>	Medical personnel required for competition.
Texas	could not locate	
Utah	<a href="http://uhsaa.org/Publications/Handbook/Handbook.pdf">http://uhsaa.org/Publications/Handbook/Handbook.pdf</a>	Medical personnel required for championship competitions. Recommended for all other competition/practice.
Vermont	<a href="http://www.vpaonline.org/Page/33">http://www.vpaonline.org/Page/33</a>	AT recommended.
Virginia	<a href="http://www.vhsl.org/sportsmed">http://www.vhsl.org/sportsmed</a>	AT recommended.
Washington	<a href="http://www.wiaa.com/ConDocs/Con1629/2016-17%20Handbook%20Final%20(8-11).pdf">http://www.wiaa.com/ConDocs/Con1629/2016-17%20Handbook%20Final%20(8-11).pdf</a>	AT recommended.
West Virginia	<a href="http://www.wvssac.org/sports-medicine-news/">http://www.wvssac.org/sports-medicine-news/</a>	AT recommended.
Wisconsin	WIAA medical procedures guide- WI requires Med prof available onsite or by phone for any activity	School required to have access to medical personnel.
Wyoming	<a href="http://www.whsaa.org/handbook/Handbook.pdf">http://www.whsaa.org/handbook/Handbook.pdf</a>	AT recommended.

## **APPENDIX B**

### **SURVEY**

Survey: *Do Athletic Trainers have a positive impact on high school athletes' knowledge and implementation of injury prevention strategies?*

- 1) What year did you graduate from high school?  
Spring 2015  
Before 2015
- 2) What high school did you attend? (Name and State)
- 3) What sport did you play in high school?
- 4) How many years have you participated in your sport?
- 5) What is your gender?  
Male  
Female  
Other
- 6) Did you have an Athletic Trainer available at your high school?  
Yes  
No  
Not sure
- 7) Was your Athletic Trainer certified?  
Yes  
No  
Not sure
- 8) Have you consulted with an Athletic Trainer since attending college?  
Yes  
No  
Not sure
- 9) Have you ever been injured from sport before? If so, please describe your injury.
- 10a) Did you know hamstring strength (the muscles in the back of your thigh) is a factor in ACL injury?  
Yes  
No (If no, skip to question 11a)
- 10b) Where did you learn this? Select all that apply  
Doctor  
Coach  
Parents  
Internet  
Teammates  
Athletic Trainer

Physical Therapist

10c) Do you incorporate any hamstring strengthening protocols specifically for the purpose of injury prevention, not just fitness and strength?

Yes

No

11a) Did you know rotator cuff weakness is associated with shoulder injuries especially in throwing athletes?

Yes

No (If no, skip to question 12a)

11b) Where did you learn this? Select all that apply

Doctor

Coach

Parents

Internet

Teammates

Athletic Trainer

Physical Therapist

11c) Do you incorporate any rotator cuff strengthening protocols specifically for the purpose of injury prevention, not just fitness and strength?

Yes

No

12a) Did you know quadriceps weakness (the muscles in the front of your thigh) can contribute to patellofemoral pain (pain in the front of your knee joint)?

Yes

No (If no, skip to question 13a)

12b) Where did you learn this? Select all that apply

Doctor

Coach

Parents

Internet

Teammates

Athletic Trainer

Physical Therapist

12c) Do you incorporate any quad strengthening protocols specifically for the purpose of injury prevention, not just fitness and strength?

Yes

No

13a) Did you know hip weakness can contribute to patellofemoral pain (pain in the front of your knee joint)?

Yes

No (If no, skip to question 14a)

13b) Where did you learn this? Select all that apply

Doctor

Coach



Parents  
Internet  
Teammates  
Athletic Trainer  
Physical Therapist

13c) Do you incorporate any hip strengthening protocols specifically for the purpose of injury prevention, not just fitness and strength?

Yes  
No

14a) Did you know scapular stability (stability of your shoulder blade) is a factor in preventing shoulder injury?

Yes  
No (If no, skip to question 15a)

14b) Where did you learn this? Select all that apply

Doctor  
Coach  
Parents  
Internet  
Teammates  
Athletic Trainer  
Physical Therapist

14c) Do you incorporate any scapular stability protocols specifically for the purpose of injury prevention, not just fitness and strength?

Yes  
No

15a) Did you know a lack of flexibility in the hips can contribute to low back pain?

Yes  
No (If no, skip to question 16a)

15b) Where did you learn this? Select all that apply

Doctor  
Coach  
Parents  
Internet  
Teammates  
Athletic Trainer  
Physical Therapist

15c) Do you incorporate any hip flexibility protocols specifically for the purpose of injury prevention, not just fitness and strength?

Yes  
No

16a) Females only: Did you know female athletes have a greater risk of ACL injury than male athletes?

Yes  
No (If no, skip to question 17a)  
I am not female

16b) Where did you learn this? Select all that apply

- Doctor
- Coach
- Parents
- Internet
- Teammates
- Athletic Trainer
- Physical Therapist

16c) Do you incorporate any specific ACL prevention protocols above and beyond any protocols the male teams do?

- Yes
- No

17a) Did you know abdominal strength and core stability can reduce low back pain?

- Yes
- No (If no, you have completed the survey)

17b) Where did you learn this? Select all that apply

- Doctor
- Coach
- Parents
- Internet
- Teammates
- Athletic Trainer
- Physical Therapist

17c) Do you incorporate any core stability protocols into your training specifically for the purpose of injury prevention, not just abdominal fitness like crunches?

- Yes
- No

18a) Did you know concussion symptoms can vary greatly from person to person?

- Yes
- No

18b) Where did you learn this? Select all that apply

- Doctor
- Coach
- Parents
- Internet
- Teammates
- Athletic Trainer
- Physical Therapist

18c) Did your school require you to participate in concussion baseline testing such as IMPACT or BESS?

- Yes
- No

Thank you for your participation. Please detach the consent form from the survey and return them to their respective drop boxes.

## REFERENCES

## REFERENCES

- Almquist, J., Valovich McLeod, T.C., Cavanna, A., Jenkinson, D., Lincoln, A., Loud, K.,... Woods, T. (2008). Summary statement: Appropriate medical care for the secondary school-aged athlete. *Journal of Athletic Training*, 43(4), 416-427.
- Alvarez-Bueno, C., Rodriguez-Martin, B., Garcia-Ortiz, L., Gomez-Marcos, M., & Martinez-Vizcaino, V. (2014) Effectiveness of brief interventions in primary health care settings to decrease alcohol consumption by adult non-dependent drinkers: A systematic review of systematic reviews. *Preventive Medicine*. doi 10.1016/j.ypmed.2014.12.010
- Armfield, D., Sickel, R., Robertson, D., Towers, J., & Debski, R. (2003). Biomechanical basis of common shoulder problems. *Seminars in Musculoskeletal Radiology*, 7(1), 5-18.
- Aukerman, D., Aukerman, M., & Browning, D. (2006). Medical coverage of high school athletes in North Carolina. *Southern Medical Journal*, 9(2), 132-137.
- Baker, D.W., Feinglass J., Durazo-Arvizu R., Witt W.P., Sudano J.J., & Thompson J.A. (2006). Changes in health for the uninsured after reaching age-eligibility for Medicare. *Journal of General Internal Medicine*, 21(11), 1144-1149.
- Barr, K., Griggs, M., & Cadboy, T. (2005). Core concepts and current literature part I. *American Journal of Physical Medicine and Rehabilitation*, 81(6), 473-480.
- Bass, J., Christoffel, K., Windom, M., Boyle, W., Scheidt, P., Stannic, R., & Roberts, K. (1993). Childhood injury prevention counseling in primary care setting: A critical review of literature. *Pediatrics*, 92(4), 544-552.
- Bassi, N., Karagodin, I., Wang, S., Vassallo, P., Priyanath, A., Massaro, E., & Stone, N. (2014). Lifestyle modifications for metabolic syndrome: A systematic review. *American Journal of Medicine*, 127(12), 1242-1251.
- Board of Certification. (2013) State Regulations. Retrieved from <http://www.bocattc.org/state-regulation/faqs>
- Board of Certification. (2016). *State regulations*. Retrieved from <http://www.bocattc.org/index.php/state-regulation>.
- Boden, B., Tacchetti, R., Cantu, R., Knowles, S., & Mueller, F. (2007). Catastrophic injuries in high school and college basketball players. *American Journal of Sports Medicine*, 35(7), 2328-2335.

- Borowski, L., Yard, E., Fields, S., & Comstock, D. (2008). Epidemiology of high school basketball injuries: 2005-2007. *American Journal of Sports Medicine*, 36(12), 2328-2335.
- Borsa, P., Laudner, K., & Saures, E. (2008). Mobility and stability adaptations of the shoulder in the overhead athlete: A theoretical evidence based perspective. *Sports Medicine*, 38(1), 17-36.
- California Interscholastic Federation. (2016). *Sports medicine handbook*. Retrieved from [http://www.cifstate.org/sports-medicine/handbook/Sports\\_Med\\_Handbook\\_March\\_30\\_2011.pdf](http://www.cifstate.org/sports-medicine/handbook/Sports_Med_Handbook_March_30_2011.pdf).
- Carek, J. (1999). Health care coverage of high school athletics in South Carolina: does school size make a difference? *Journal of South Carolina Medical Association*, 40(11), 420-425.
- Colorado High School Athletic Association. (2016). *Sports medicine advisory handbook*. Retrieved from <http://www2.chsaa.org/sports/medicine/SPORTSMEDICINEHANDBOOK2016.pdf>.
- Commission on Accreditation of Athletic Training Education. (2016). *Standards*. Retrieved from <http://caate.net/category/standards/>
- Connecticut Interscholastic Athletic Conference. (2016). *Handbook*. Retrieved from [http://www.casciac.org/pdfs/ciachandbook\\_1617.pdf](http://www.casciac.org/pdfs/ciachandbook_1617.pdf).
- Darrow, C., Collins, C., Yard, E., & Comstock, D. (2009). Epidemiology of severe injuries among high school athletes: 2005-2007. *American Journal of Sports Medicine*, 37(9), 1798-1805.
- Delforge, G., & Behnke, R.. (1999). The history and evolution of athletic training education in the United States. *Journal of Athletic Training*, 34(1), 53-61.
- DePalma, M., & Johnson, E. (2003). Detecting and treating shoulder impingement syndrome: The role of scapulothoracic dyskinesis. *The Physician and Sports Medicine*, 31(7).
- Dolak, K., Silkman, C. McKeon, J., Hoset, R., Latterman, C., & Uhl, T. (2011). Hip strengthening prior to functional exercise reduces pain sooner than quadriceps strengthening in females with patellofemoral pain syndrome: A randomized control trial. *Journal of Orthopedics and Sports Physical Therapy*, 41(8), 560-570.
- Earl, J., & Hoch, A. (2011). A proximal strengthening program improves pain, function and biomechanics in women with patellofemoral pain syndrome. *American Journal of Sports Medicine*, 39(1), 154-164.

- Emery, C., Meeuwisse W., & Hartman, S. (2005). Evaluation of risk factors for injury in adolescent soccer: Implementation and validation of an injury surveillance system. *American Journal of Sports Medicine*, 33(12), 1882-1891.
- Feder, K., Frey, C., Sleight, J., Pendergraph, B., & Smallman, D. (2010). Medical coverage of high school athletes in California. *Athletic Training and Sports Health Care*, 1(1), 61-65.
- Feinglass, J., Nonzee, N., Lurie, R., Murphy, K., Endress, R., & Simon, M. (2014). Access to care outcomes: A telephone interview study of suburban safety net program for the uninsured. *Journal of Community Health*, 39(1), 108-117.
- Florida High School Athletic Association. (2016). *By-laws*. Retrieved from [https://www.fhsaa.org/sites/default/files/attachments/2010/09/16/node-235/1617\\_handbook\\_full\\_revised\\_0.pdf](https://www.fhsaa.org/sites/default/files/attachments/2010/09/16/node-235/1617_handbook_full_revised_0.pdf).
- Georgia High School Association. (2016). *Constitution and by-laws* Retrieved from <http://www.ghsa.net/sites/default/files/documents/Constitution/Constitution2016-17Complete.pdf>.
- Gessel, L., Fields, S., Collins, C., Dick, R., & Comstock, R. (2007). Concussions among high school and collegiate athletes. *Journal of Athletic Training*, 42(4), 495-508.
- Griffin, L., Albhom, M., & Arendt, E. (2006). Understanding and preventing non contact anterior cruciate ligament injuries: A review of the Valley Hunt II meeting, January 2005. *American Journal of Sports Medicine*, 39(4), 1512-1532.
- Guskweicz, K., Bruce, S., Cantu, R., Ferrara, M., Kelly, J., McCrea, M... Valvovich McLeod, T. (2004). National Athletic Trainers' Association position statement: Management of sport related concussion. *Journal of Athletic Training*, 39(3), 280-297.
- Heck, J., Clarke, K., Peterson, T., Torg, J., & Weis, M.. (2004). National Athletic Trainers Association position statement: Head-down contact and spearing in tackle football. *Journal of Athletic Training*, 39(1), 101-111.
- Hootman, J., Dick, R., & Agel, J. (2007). Epidemiology of collegiate injuries for 15 sports: Summary and recommendations for injury prevention initiatives. *Journal of Athletic Training*, 39(2), 311-319.
- Hoyle, R. & Leff, S. (1997). The role of parental involvement in youth sport participation and performance. *Adolescence*, 32(125), 233-243.

- Johnson, S. B. (2010) *The 2009 athletic trainer role delineation study*. Omaha, NE: Board of Certification.
- Junge, A., Rosch, D., Peterson, L., Graf-Baumann, T., Dvorak, J.. (2002). Prevention of soccer injuries: A prospective intervention study in youth amateur players. *American Journal of Sports Medicine*. 30, 652-659.
- Kerr, Z., Lynall, R., Mauntel, T., & Dompier, T. (2016). High school athlete football injury rates and services by athletic trainer employment status. *Journal of Athletic Training*, 51(1), 70-73.
- Kerr, Z., Roos, K., Schmidt, J., & Marshall, S. (2013). Prevention and management of physical and social environmental risk factors in sports related injuries. *American Journal of Life Medicine*, 7(2), 138-153.
- Kibler, W. (1998). The role of the scapula in athletic shoulder function. *American Journal of Sports Medicine*, 26(2), 325-337.
- Knowles, S., Marshall, S., Miller, T., Spicer, R., Bowling J.W., Loomis, D... Mueller, F.O. (2007) Cost of injuries from a prospective cohort study of North Carolina high school athletes. *Injury Prevention*, 13, 413-421.
- Korczak, D., Deitl, M., & Seinhauser, G. (2011). Effectiveness of programmes as a part of primary prevention demonstrated on the example of cardiovascular disease and the metabolic syndrome. *GMS Health Technology Assessment*, doi 10.3205/hta000093.
- LaBatz, M. (2004). Patellofemoral syndrom: Diagnosed pointers and individualized treatment. *The Physician and Sports Medicine*, 32(7). doi 10.3810/psm.2004.07.439
- Lephart, S., Abt, J., & Ferris, C. (2002). Neuromuscular contributions to anterior cruciate ligament injuries in females. *Current Opinions in Rheumatology*, 14, 168-173.
- McCroy, P., Meeuwisse, W., Johnston, K., Dvorak, J., Aubry, M., Molloy, M., & Cantu, R. (2009). Consensus statement on concussions in sport 3rd International Conference on Concussion in Sport held in Zurich, November 2008. *Clinical Journal of Sports Medicine*, 19, 185-200.
- McGuine, T. (2006). Sports injuries in high school athletes: A review of injury-risk and injury-prevention research. *Clinical Journal of Sports Medicine*, 16(6), 488-499.
- Musich, S., Klemes, A., Kuica, M., Wang, S., & Hawkins, K. (2014). Personalized preventive care reduces health care expenditures among Medicare advantage beneficiaries. *American Journal of Managed Care*, 20(8), 613-620.

- Nadler, S., Malanga, G., DePrince, M., Stitik, T., & Feinberg, J. (2000). The relationship between lower extremity injury, low back pain and hip muscle strength in male and female collegiate athletes. *Clinical Journal of Sports Medicine*, 10(2), 89-97.
- National Athletic Trainers' Association (2011). *Athletic training education competencies*. Retrieved from [https://www.nata.org/sites/default/files/competencies\\_5th\\_edition.pdf](https://www.nata.org/sites/default/files/competencies_5th_edition.pdf).
- National Collegiate Athletics Association (2014). *Sports medicine handbook*. Retrieved from <https://www.ncaa.org/sites/default/files/2013-14%20Sports%20Medicine%20Handbook.pdf>
- National Federation of High School Associations, (2016). *Sports medicine guidelines*. Retrieved from <http://www.nfhs.org/sports-resource-content/smac-position-statements-and-guidelines/>.
- Nelson, A., Collins, C., Yard, E., Fields, S., & Comstock, D. (2007). Ankle injuries among United States high school sport athletes 2005-2006. *Journal of Athletic Training*, 42(3), 381-387.
- New Mexico Activities Association. (2016). *Handbook*. Retrieved from <http://www.nmact.org/nmaa-handbook>.
- Oller, D., Vairo, G., Sebastianelli, W., & Buckley, W. (2013). Injury/illness physician referral profile from a youth university-sponsored summer sport camp program. *Clinical Pediatrics*, 52(8), 730-738.
- Pennsylvania Interscholastic Athletics Association (2016). *Sports medicine guidelines*. Retrieved from <http://www.piaa.org/assets/web/documents/Handbook%20-%20Section%20VI%20-%20Sports%20Medicine.PDF>.
- Powers, C. (2010). The influence of abnormal hip mechanics on knee injury: A biomechanics perspective. *Journal of Orthopedics and Sport Physical Therapy*, 40(2), 42-51.
- Purcell, L., & Micheli, L. (2009). Low back pain in young athletes. *Sports Health*, 1(3), 212-223.
- Quandt, E., Mitten, M., & Black, J. (2009). Legal liability in covering athletic events. *Sports Health*, 1(1), 85-90.
- Randazo, C., Nelson, N., & McKenzie, L. (2010). Basketball-related injuries in school-aged children and adolescents in 1997-2007. *Pediatrics*, 126(4), 727-733.



- Resch, J. & Kutcher, J. (2015). The acute management of sport concussion in pediatric athletes. *Journal of Child Neurology*, 30(12), 1686-1694.
- Solingard, T., Myklebust, G., Steffen, K., Holme, I., Silvers, H., Bizzini, M... Andersen, T. (2008). Comprehensive warm-up programme to prevent injuries in young female footballers: Cluster randomized control study. *British Medical Journal*, doi 10.1136/bmj.a2469.
- Sommers B.D, Baicker K., & Epstein A.M. (2012). Mortality and access to care among adults after state Medicaid expansions. *New England Journal of Medicine*, 367(11), 1025-1034.
- Swenson, D., Henke, N., Collins, C. Fields, E., & Comstock, D. (2012). Epidemiology of high school sports- related fractures, 2008-09 to 2010-11. *American Journal of Sports Medicine*, 40(9):2078-2084.
- Swenson, D., Yard, E., Fields, S., & Comstock, D. (2009). Patterns of reoccurrent injuries among high school athletes, 2005-2008. *American Journal of Sports Medicine*, 37(8), 1586-1593.
- Waryasz, G., & McDermott, A. (2008). Patellofemoral pain syndrome (PFPS): A systematic review of anatomy and potential risk factors. *Dynamic Medicine*, doi 10.1186/1476-5918-7-9.
- Weitzel, R., Miller, M., Gionatta, R., & Newman, C. (2016). High school athletes' parents' perception and knowledge of the skills and job requirements of the certified athletic trainer. *Journal of Athletic Training*, 50(12), 1286-1291.
- Wham, G., Saunders, R., & Mensch, J. (2010). Key factors for providing appropriate medical care in secondary school athletics: Athletic training services on a budget. *Journal of Athletic Training*, 45(1), 75-86.
- Will, K., Obma, P., Simpson, C., Cain, E., Dugas, J., & Andrews, J. (2009). Shoulders in the overhead athlete. *Journal of Orthopedic and Sports Physical Therapy*, 39(2), 38-54.
- Yards, E., Collins, C., & Comsock, D. (2009). A comparison of high school sports injury surveillance data reporting by certified athletic trainers and coaches. *Journal of Athletic Training*, 44(6), 645-652.