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An Epidemiology of Recreational Sport Injury Rates at Clemson University

David Jameyson
Clemson University, djameys@clemson.edu

AN EPIDEMIOLOGY OF RECREATIONAL SPORT INJURY RATES AT CLEMSON UNIVERSITY

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David Richard Jameyson
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Dr. Skye Arthur-Banning, Committee Chair
Dr. Robert Brookover
Dr. Brent Hawkins

ABSTRACT

Injuries are one of the common risks associated with physical activity, and in certain populations, injury prevention methods are used to improve the leisure experience for participants. At the collegiate level of sports participation, NCAA sports programs are required to provide injury treatment and prevention options for their athletes. For participants competing in club and intramural sports, no universal requirements for injury prevention and treatment exist. This study assessed the risk of injury during sports participation at the club and intramural level in a college-aged population. Campus recreation incident reports and Certified Athletic Trainer evaluations were used to document the activity, type, frequency, and location of injury in this population. Club sport participants were found to have a significantly higher overall rate of injury compared to previously documented injury rates in NCAA participants, while, both NCAA and club sports participants were found to be more at risk than intramural participants. Club sport participants were also found to be more at risk of suffering a head, neck, upper extremity, lower extremity, and back injury than NCAA participants. Specific sport injury rates were documented for nine club sports and compared with NCAA injury data. These injury rates suggest a need for improved health care and preventative treatment options for club sport athletes, especially men's and women's club rugby.

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CHAPTER ONE

INTRODUCTION

The sports medicine industry is a multi-billion dollar industry that encompasses the medical treatment and care of injured athletes (Conn, Annest, & Gilchrist, 2003; McGuine, 2010). The industry has grown rapidly in the past few decades due to the increasing number of people playing competitive sports and, as a result, a larger number of injuries that occur while playing. In the United States, roughly 7.5 million students participate in competitive sports at the high school level alone, which also results in about 1.4 million injuries annually ranging from both lower and upper extremity injuries, concussions, and other common orthopedic injuries (McGuine, 2010; The National Federation of State High School Association (NFHS), 2013). The estimated cost for the direct and indirect treatment of these injuries is over $6.7 billion a year (2010). The high number of participants in competitive sports and the cost involved has encouraged many institutions to employ medical staff such as a physician, physical therapist, or certified athletic trainer on a full time basis to improve the quality of care for participants. This not only decreases the number of injuries, but also provides participants a means for treatment after an injury occurs, and in most cases, gives them a more affordable option for treatment (National Athletic Trainers' Association, 2002; 2007).

Employing a full time medical staff is most common at the professional and intercollegiate levels, and has been growing dramatically in the high school setting. However, this treatment and standard of care is rarely provided at the collegiate intramural, club, and recreation level, even though the activities involved are often

similar in many cases. The National Intramural-Recreational Sports Association (NIRSA) (2005), reported an estimated 5.3 million students considered themselves regular users of campus recreation facilities and programs. Since the number of participants in sport related activities is steadily increasing, the number of sport related injuries is also likely to increase. Injuries may occur at this level due to: decreased fitness and conditioning compared to competitive sport participants, a lack of experience in participants, and few preventative treatment options available. Previous studies have been conducted to record the frequency, type, and mechanisms of injury at the NCAA intercollegiate level to document the need for daily medical treatment options (Hootman, Dick, & Agel, 2007). However, very little research has been done to show the need for treatment options at the intramural, club, and recreational sport level, even though the number of participants is greater in these various levels of organized sport (NIRSA, 2005, The National Collegiate Athletic Association, 2012).

Many organizations are looking for low cost methods to increase the medical care options for participants including through outreach programs and non-profit organizations; for example, a high school may hire a Certified Athletic Trainer by using an outreach program offered through a physical therapy clinic. The athletic trainer would then be able to refer patients back to the clinic to make the medical care financially sustainable for both parties. In a recreation setting it is more difficult to employ medical staff on a full time basis because there may be fewer revenue generating opportunities. Regardless of financial implications, the number of participants in club, intramural, and

recreational sports with potential for injury warrants a need for some level of medical coverage.

The National Athletic Trainers Association's (NATA) definition of "appropriate medical coverage" goes well beyond the need for an emergency action plan. Other duties recommended include daily interaction with student athletes to assess risk of injury, injury prevention, evaluation and immediate care of injury, rehabilitation, psychosocial interaction and nutritional aspects of sports to name a few (National Athletic Trainers Association, 2007). The NATA and NCAA have also created a scale to determine what amount of coverage is appropriate for each sport based on the potential risk of injury and the potential risk of a life threatening injury. The risk of any injury most frequently includes mild to moderate injuries that limit participation temporarily, but do not have a long term impact on performance, while more severe injuries will result in an extended period of time out of activity, can have long term consequences, and could potentially impact the quality of life outside of sport (National Athletic Trainers Association, 2007).

Using this model, each NCAA sport was placed in a category ranging from low to high risk based on the total risk of injury involved. Sports that have been categorized as high risk such as football, wrestling, and gymnastics must have medical personnel present at every team game and practice. A low risk sport such as baseball or softball may only require a member of the team or coaching staff to have first aid or CPR training in case of an emergency (Hootman, Dick, & Agel, 2007).

This scale is only enforced with NCAA programs, while medical coverage for club sports, intramural sports, and recreational sports are usually determined by each

institution. The decision for medical coverage at these recreational events may only be based on the potential for catastrophic injury and may not include the potential for all mild to moderate injuries that will not have permanent consequences. This can be a serious discrepancy based on the competition level. For example, at the professional and NCAA intercollegiate level, an ambulance and EMS team are required at almost every game. This is also true at most high school football games as well. At the club sport collegiate level, the rules of the game are exactly the same. Players are in full padding and helmets, and it is a high contact sport, but there is no regulation or requirements for universal medical coverage at these events. This may result in unsafe playing conditions for participants, or at the very least, a decrease in the medical care options available to participants. If a student athlete were to get injured at a university sanctioned event and no one was there to coordinate medical care, the university may be held responsible.

A lack of literature about the injury rates at the club sport level of competition may be a factor in the decision about necessary medical coverage. This research will help to determine if the total number of injuries and the risk involved requires a universal set of guidelines or requirements for appropriate medical coverage. Currently, regulations for club sports are set by the individual conferences that the team is a part of rather than the national organization, NIRSA.

This study assessed the injury rates in a college age population for club, intramural and recreational sport participants to determine if there is a need for medical coverage at these sporting events. A retrospective analysis of injury reports collected over a two year period was conducted to document the type, frequency, activity, and

mechanism of all injuries suffered during recreational sport participation. The results were then compared with previous NCAA injury literature to determine if the injury rate and catastrophic injury potential convey the need for medical coverage at this level of competition.

CHAPTER TWO

LITERATURE REVIEW

This purpose of this section is to examine previous research in the related subject areas and to influence the direction of the research questions and methods. Before comparing data on different populations, it is important to understand the similarities and differences between populations and activities. The activities being completed are very similar between groups, however the benefits and risks of activity, level of competition, physical demand, and injury prevention measures are likely to vary. These differences will need to be taken into consideration when comparing population results. The following section will examine previous research and topics including: sport participation, benefits and risks of sport, sports injuries, levels of competition, and injury prevention measures.

Sport Participation

Participation in sports is one of the most popular forms of exercise and physical activity in the world (Kerr, Roos, Schmidt, & Marshall, 2012). Sports can be categorized as either individual or team, where traditionally, participants follow a common set of rules and progress towards a goal (Khan et al., 2012). Each sport has unique rules, strategies, and physical demands, making them a popular form of physical activity for a large portion of the population.

Population-wide sport participation rates are not easily measured in the United States. However, within certain sub-populations, accurate representations are available. For example, the National Federation of State High Schools Association (NFHS)

documents participation rates at the high school level, while the National Collegiate Athletic Association (NCAA) is one of the major organizations at the collegiate level. In the 2012-2013 year, over 7.7 million students participated in sports at the high school level (NFHS, 2013), while the number of NCAA athletes has increased to over 450,000 during the 2011-2012 school year (NCAA, 2012). Only a small percentage of high school students are good enough to continue playing sports in college as a part of an NCAA athletic program (Pennington, 2008). At the collegiate level, many students continue their participation in sport by competing in intramural, club sport, or recreational programs. Over two million students participate in club sports annually (Pennington, 2008), while over five million students consider themselves regular users of campus recreation facilities and programs including intramural and recreational programs (NIRSA, 2005). Since sports participation takes place on a variety of levels, the benefits and risks of activity may vary significantly based on physical activity, level of competition, and behavior.

Benefits and Risks of Sport

The benefits of sport are most easily measured by the amount of physical activity required for each activity, where, generally, an increase in the duration of the physical activity or an increase in the intensity of the activity will correlate with a positive increase in health benefits (Eime et al., 2013). The American College of Sports Medicine and American Heart Association have established guidelines to receive the most benefit from physical activity. They recommend at least 20-30 minutes of exercise at least 5 days a week for adults (Haskell et al., 2007). Similarly, the United States Department of

Health and Human Services recommends at least 75 minutes of vigorous intensity aerobic physical activity or at least 150 minutes of moderate intensity physical activity a week (United States Department of Health and Human Services, 2008). Any level of physical activity is better than living a sedentary lifestyle in terms of the health benefits received from physical activity (Eime et al., 2013).

The United States Department of Health and Human Services (2008) also describes a wide range of specific health benefits of physical activity. The report suggests physical activity is strongly linked with a reduced risk of early death, cardiovascular disease, stroke, high blood pressure, type II diabetes, breast and colon cancer, weight gain, depression, and a loss of cognitive function (Powell, Paluch, & Blair, 2011; United States Department of Health and Human Services, 2008). Maintained weight loss, improved sleep quality, maintained functional ability, and a reduced risk of osteoporosis were also reported to be moderately linked with physical activity outcomes (Powell, Paluch, & Blair, 2011; United States Department of Health and Human Services, 2008). These benefits are all related to the volume of physical activity completed, and can be achieved through regular sports participation, depending on the sport demands and intensity.

This only accounts for the physical health benefits of activity, and may not truly represent the impact sport participation has on the entire health spectrum. A well rounded regular physical activity program will promote a healthy lifestyle by incorporating practices that address physical, social, and mental domains (Eime et al., 2013). The most common social and psychological health benefits of frequent sports participation in

children and adolescents was improved self-esteem, improved social interaction, and a decrease in symptoms related to depression (Eime et al., 2013). Team sports in particular help promote social interactions, which can influence the quality of life both positively and negatively (Khan et al., 2012).

Sport participation has been linked to increased student success at the collegiate level as well. Students who participate in campus recreation sports programs have higher overall grade point averages than students who do not participate in such programs (Gibbison, Henry, & Perkins-Brown, 2011). Participation in collegiate sport programs has also been shown to increase student retention (Huesman, Brown, Lee, Kellogg, & Radcliffe, 2009). Increased grade point averages and student retention are valuable for both the student and the university. The sense of community and belonging established during sports participation will be impacted by how involved each student is in that activity, and what is necessary for participation. The benefits of sport will obviously vary between different activities due to the unique demands, skills, and requirements to participate in each. Along with the physiological benefits received from the amount of physical activity, social and mental health benefits will be influenced by the amount and quality of the social interaction during the activity. Even though the physical activity required for sports participation has been shown to provide numerous health benefits, the increased risks of frequent sports participation, in particular, sports injuries must also be considered.

Sports Injuries

Generally, sports injuries can be classified into either acute or chronic. Acute injuries are the result of one specific incident, they occur suddenly, and typically have a clearly defined mechanism of injury (Bahr, et al., 2012) such as direct contact with another player or falling on a hard surface. Acute injuries are most common in high speed or contact sports such as soccer, football, basketball, hockey, or skiing (Bahr & Holme, 2003). Sports and recreational activities with the most physical contact, force, and speed result in the highest number of acute injuries (Bahr et al., 2012). Chronic injuries are most common in long training duration, repetitive, or routine sports such as cross country running, tennis, bicycling, or golf (NATA, 2011). Chronic injuries result when the workload or stress placed on the body over a period of time is too great (NATA, 2011). The inflammation and recovery process cannot keep up with the training demand which leads to injury (Bahr et al., 2012; NATA, 2011).

Types of Injuries. Another factor to consider is the types of injuries commonly seen during sport and recreational activity. Besides being classified as either chronic or acute, injuries are generally applied to either soft tissue (muscle, tendon, cartilage, or ligament) or skeletal injuries (fractures) (Maehlum & Daljord, 1984). Some of the most common soft tissue injuries are strains, sprains, contusions, ruptures, and superficial injuries. Common skeletal injuries deal with various types or fractures and dislocations (Schneider et al, 2012; Junge et al. 2009).

Most injuries are categorized by the body region of injury; most commonly as lower extremity or upper extremity. Upper extremity injuries include finger, hand, wrist,

elbow, and shoulder injuries, while lower extremity injuries include foot, ankle, knee, and hip injuries. Head, neck, and torso injuries can also occur in sports and recreation activities (Steffen, et al., 2010). The frequency of specific sports injuries will also vary based on multiple factors such as activity, level of competition, and participant characteristics, skill, and ability. To represent the risk of injury for different populations and activities, injury rates are often collected and analyzed through injury surveillance systems, and can lead to more informed injury prevention initiatives.

Injury Rates. Since 1982, the NCAA has been collecting injury and exposure data for collegiate sports through its Injury Surveillance System (ISS) (Hootman, Dick, & Agel, 2007). Hootman, Dick, and Agel's (2007) epidemiology of collegiate injuries was a well-documented examination of the injury rates for 15 sports over a 16 year period. Many interesting conclusions can be drawn from this particular study. To determine the injury rates per sport, the researcher documented every injury that required at least 1 day of practice to be missed and compared that to the number of athlete exposures to activity. Games were shown to have almost four times the amount of injuries compared to practices or off season training. The report also described the injury rates for different sports to provide recommendations for the medical care necessary.

Injury ratios were created with the number of injuries compared with the number of sport interactions represented as athlete exposures (A-Es). So for example, one athlete participating in one practice would equal one athletic exposure. Men's football had the highest number of injuries during games at 35.9 injuries per 1,000 athlete exposures (A-Es) and during practices at 9.6 injuries per 1,000 A-Es, followed by wrestling at 26.4

injuries per 1,000 A-Es (Hootman, Dick, & Agel, 2007). Baseball was the lowest risk men's sport at only 5.8 injuries per 1,000 A-E's. Women's soccer had the highest number of game injuries for a women's recorded sport at 16.4 injuries per A-E's, while softball had the fewest at only 4.3 injuries per 1,000 A-E's (Hootman, Dick, & Agel, 2007).

Since this study was longitudinal, it was also able to provide data and trends for different injuries over time. Over the course of 16 years, lower extremity injuries (50% of injuries) in general, and ankle sprains (15% of injuries) specifically were the most frequently documented injuries and remained fairly constant during that time. Other injury rates have changed significantly during that period. Concussions and ACL injury rates increased the most on an annual basis (7.0% and 1.3% respectively). One of the explanations for the increase on a regular basis is the improvements in identification of these injuries in recent years. Concussions in particular have been given a lot of attention from the sports medicine community, especially as long term results and studies continue to show the negative health effects years after injury (Hootman, Dick, & Agel, 2007). The longitudinal study helped establish the medical care guidelines and recommendations from the National Athletic Trainers' Association, as well as show a need for varying amounts of medical coverage for each sport at the NCAA level.

The hospitalization rates of injury visits related to sport and recreation is also high (Finch & Boufous, 2009). Mattila et. al (2009), found that the strongest risk factor for hospitalization in a 14-18 year old population was a frequent participation in club sports or recreational sports. Those who participated 3-4 times a week in organized sports were 1.8 times and 2.4 times more likely to suffer an injury that required hospitalization in

males and females respectively. As a comparison, other risk factors such as daily smoking or binge drinking only had an injury rate of 1.4 and 1.6 during that same time period (Mattila et. al, 2009). The number of patients in the hospital for conditions related to smoking, drinking, or even car accidents was likely much higher than those related to sports participation, however the frequency of hospitalization compared with the amount of interaction in the activity was highest in sports participants. So, for example, playing an organized sport three times would equal three interactions with the sport, and is more likely to cause an injury that requires hospitalization than a person that has one interaction with binge drinking. This shows how much of a risk factor participation in sports can be. Even in a widely accepted set of activities, such as organized recreational sports, the injury rate is substantial compared to other risk factors that are addressed more seriously.

Injuries are not limited to competitive team sports either. Non-competitive sport and recreation events will also have varying injury rates based on the activity. The results of a six year outdoor education study found that injury rates were highest in mountain biking (7.5 injuries/1,000 participant days), climbing (5.0 injuries/1,000 participant days), and kayaking (4.4 injuries/1,000 participant days), compared to other outdoor recreation activities (Gaudio, Greenwald, & Holton, 2010). Regardless of the type of activity, any time there is an increase in the number of injuries, an investigation should be done to determine ways to mitigate the risk of future injuries. Some events such as kayaking or hiking may be difficult to implement medical care during the activity, but options are available before and after the activity to possibly reduce the risk of injury and

to treat sustained injuries more appropriately and decrease severity. Even though recreational sports are usually considered leisure activities, they still have increased injury rates compared to other activities, and should be treated seriously.

At the collegiate club sport and intramural levels of competition, very little is known about national injury rates. This may be because the National Intramural-Recreational Sports Association (NIRSA) does not currently have an injury reporting system. Institutions are also not required to be a part of NIRSA to support intramural and club sport programs. Each institution likely has their own injury rates, but the trends for the entire population are largely unknown.

Mechanisms of Injury. In any type of sport and recreation activity, competitive or non-competitive, one of the most commonly used predictors of injury risk is the training demand. Injuries will be more or less likely to occur depending on the training demands required for that activity, especially with competitive sport. Highly competitive activities often require physical fitness, and to improve physical fitness, the body needs to be trained and challenged on a regular basis. The training demands need to be great enough to basically wear down the body so it can build itself up stronger during the recovery portion. Since the athlete must challenge himself or herself with a high intensity of exercise, it is very easy to overload the body with too much force or too much stress and cause injury.

The specific activity will also have an influence on the potential risk involved in physical activity. Recently, advanced technology, more advanced play, and more participants in high-risk activities have resulted in more injuries in team sports such as

football and hockey, as well as individual sports such as snowmobiling or driving an all-terrain vehicle (ATV) (Tator, 2011). This has also been shown to relate to injuries seen in physical education students, with the most common injuries resulting from participation in higher risk sports such as football, soccer, basketball, and volleyball (Ray & Kohandel, 2010). The activity and environment will have a considerable impact on the potential risk, but participants can actively respond to these inherent risks through their behavior during the activity.

Behavior can result in an increase in injury risk or a decrease in injury risk. Organizations, players, coaches, referees, medical staff, and the individual can all produce different behaviors that interact and influence the overall risk of injury (Verhagen, Stralen, & Mechelen, 2010). This behavior or outcome is determined by intrinsic cognitive factors (attitude, social norm, intention) and extrinsic factors (physical and political environment) (Verhagen, Stralen, & Mechelen, 2010; Ristolainen et. al, 2009; Kerr, 2012). Behavior influences will potentially vary between different levels of competition in sport. For example, when comparing the NCAA level and the club sports level, if the participant's attitude and intention remain the same, at the NCAA level, a paid coach and a certified athletic trainer are almost always present to limit dangerous playing behavior or conditions. Campus recreation directors reported only 55% of club sports had a paid or volunteer coach and only 35% had access to a certified athletic trainer within their institution (Schneider, Stier, Kampf, Gaskins, & Haines, 2008). A lack of supervision and medical coverage at club sports events may put participants at a

greater risk of injury compared to NCAA sporting events that almost always have adult supervision and medical coverage.

Another risk factor that is difficult to control is the physical environment during activity. Heat and cold illnesses also make up a portion of the injuries sustained during athletic activity, and most of the time can be prevented with proper acclimatization and activity limits (NATA, 2002). Training and activity demands, behavior, personal characteristics, and the physical environment are just a few of the factors that can result in a sports injury. These factors are going to vary between levels of competition such as club sports and intramural sports, and may produce different injury rates because they will be more influential or less influential at each level. Different levels of competition also have varying degrees of medical care, which can impact the risk of re-injury and the recovery following injury.

Recovery following Injury. Recovery following an injury will be determined by multiple factors including: injury location, severity, type of injury, and athlete response following injury (Darrow, Collins, Yard, & Comstock, 2009). Recovery can range from as little as one day to the possibility of long-term impairment. The majority of documented injuries will result in an athlete missing at least one day of practice or competition. Darrow et al., (2009), described the recovery process for mild to moderate injuries in between 1-21 days, while severe injuries caused at least 21 days of missed activity.

Typically, more severe injuries such as fractures, high grade sprains or strains, and head injuries require a longer recovery process. This may include some measure of

rehabilitation, physical therapy, or surgical correction before a return to activity (Darrow et al., 2009). Depending on the situation, student athletes might first visit their athletic trainer for immediate and continued treatment, as well as the ability to easily connect an athlete with a physician, physical therapist, or other health care provider. Students without access to an athletic trainer typically use a campus health center or family physician as their first option for treatment.

Level of Competition

The level of competition will have an impact on the potential benefits and risks received from sports participation. In the United States, the level of competition progresses from a youth level of competition, to interscholastic at the high school level, to intercollegiate at the college or university setting, to professional competition. As the level of competition increases, so do the training demands and participation requirements. At the intercollegiate level, competition can range from recreational activity to varsity sports participation. As the level of competition changes, the rates of injury may also change due to the many factors including training demands, skill level, and injury prevention options available to participants. At the NCAA level, injury rates are more accurately documented, however, at the club sport and intramural sport levels of competition, injury rates are not reported nationally. Each population and activity will have unique demands and characteristics that can impact the rate of injury.

NCAA Sports. The National Collegiate Athletic Association (NCAA) level of competition is typically viewed as the highest level of competition at the collegiate level in the United States. The NCAA is the most popular governing body for intercollegiate

championships and competitions between member schools at the varsity level, but other governing bodies do exist including the NAIA and NJCAA (National Athletic Trainers Association, 2007). As of 2012, there are over 450,000 collegiate athletes participating in NCAA sanctioned sports (The National Collegiate Athletic Association, 2012). NCAA participants are known as varsity student-athletes, and are often recruited to be a part of the college or university team. Many NCAA athletic programs are able to offer financial incentives such as tuition assistance or stipends for these athletes to play at their institution.

Participants at this level are held to the highest standards both athletically and academically in regards to participation requirements at the collegiate level. Varsity student-athletes are the most talented and skillful athletes at the collegiate level, and will have very unique benefits and risks specific to this population, based on their training demands and abilities.

NCAA varsity athletes may potentially receive the most benefit from the physical activity required for participation compared with club, intramural, or recreational sports, since the competition standards are the highest. Because the competition level is the highest, NCAA athlete may be more at risk for injury during practices and games due to the physical demand increase placed on the body. However, since they also are the most conditioned athletes and have the most experience in the sport, they may inherently be able to mitigate the risks associated with sports participation.

Club Sports. The intermediate level of competition at the collegiate level is club sports participation. Club sports are the majority of the time student run organizations

within the campus recreation department. This level of competition has components similar to both the NCAA level of competition and the intramural level of participation.

Club sports teams will sometimes have a coaching staff, but are primarily student led. They can be a part of a conference of schools, and will play other colleges or universities typically within a region. Teams may have try-outs like NCAA sports, but will also often accept anyone willing to participate, similar to intramural sports. The social experience is a large part of club sports as a student run organization.

Club sports teams have structured practices and competitions, and the physical activity requirements usually fall in between those of NCAA and intramural sports. Participants are typically above average or average athletes, but can also be beginners. This wide variety of participants makes it difficult to predict the potential risks associated with activity at this level of competition.

Intramural Sports. Intramural sports competitions occur at the collegiate level, and are an opportunity for the entire student body to participate in organized sports or games (Hyatt, 1977). The majority of the time, intramural events only involve students from the same institution, and are run as part of a larger campus recreation department. Intramural participation is voluntary, and the primary goal is student enjoyment followed by the opportunity to promote educational experiences through physical activity (Hyatt, 1977). This level of competition is typically viewed as a leisure activity or experience since participation is voluntary with the main goal being student enjoyment. The degree of involvement can vary widely, but generally, teams and participants only compete in games and do not have structured practices, routines, or coaches.

The benefits and risks of intramural sports are unique. Students may have similar outcomes to those in club sports and NCAA sports when it comes to being more physically active. This level of competition is likely the lowest level of physical activity of the three, but students can still have positive experiences, especially in their leisure time development. Intramural activity may provide a positive leisure experience which in turn can motivate student to make more healthy life choices.

Increasing the physical activity of students will increase the benefits received from physical activity, however, intramural activities may also increase the dangers of physical activity. Since participation is open to all students, no previous experience or skill is necessary. So a first time soccer player may be competing against another student with years of experience. Sports participants with no previous experience may be more predisposed to a risk of injury during competitions because they have not been previously acclimatized, trained, and conditioned to the sport demands. Injury prevention initiatives should be used at all levels of competition to improve the quality of the leisure experience for participants.

Injury Prevention Measures

Developing sports injury prevention methods will improve the positive health benefits of sports participation and help decrease the medical costs associated with injury (Steffen et al., 2010). Injury prevention strategies should not just be implemented by the medical staff involved, but rather each organization and participant that is supporting the activity. That may include players, coaches, referees, recreation centers, and any other individual or group involved. Prevention measures should be directly established by

looking at the mechanism of injury, and will be unique for each type of injury with an attempt to limit these factors. The physical demands of sport, behavior of participants, external influences, and personal protective equipment are just a few of the mechanisms that should be included in an injury prevention program. Specific strategies that have been shown to reduce injury rates include: using equipment designed to reduce injury such as helmets, mouthguards, and shoulder pads, adapting the rules of play, and implementing specific exercise or conditioning programs to prepare an athlete for competition whenever possible (Collard et al., 2010; Steffen et al., 2010).

One way to directly prevent injuries and prepare for unavoidable injuries is through the use of a Certified Athletic Trainer (ATC). An athletic trainer is a health care professional trained to prevent, recognize, and treat injuries. Along with basic first aid and injury recognition, an athletic trainer should also be aware of an athlete's readiness to participate, psychosocial intervention and referral, nutritional aspects of sports, general medical illnesses, and when to seek emergency medical personnel for a severe injury or event (NATA, 2007). These qualifications and foundations comprise the NATA's definition of appropriate medical coverage during sporting events. This is more than a daily interaction with team members, and includes a multi-faceted approach to injury prevention and recognition.

Having a certified athletic trainer or other qualified medical personnel available at high risk activities and sports can be beneficial for multiple reasons (NATA, 2007; 2002). Medical professionals are trained in preventative measures such as taping and bracing so they can directly impact the injury rates by physical measures. Another advantage to

having a health care professional available is the time constraints that may occur in the event of a catastrophic injury. In a sport where the catastrophic injury rate is high, a delay of only a few minutes in medical care can result in the difference between life and death for an athlete (Darrow et. al, 2009). This is crucial considering the number of athletes who participate in high risk sports on a daily basis.

From the NATA's position statement on appropriate medical coverage, a scale was created to determine how many health care personnel were required for each individual sport. This scale takes into account the injury rate index (the potential injuries based on the number of athletes and the number of activity sessions) and the catastrophic index (the potential for life-threatening situations and permanent disability. The results of this injury index have helped created a classification system for the amount of necessary medical coverage based on the sport involved. Sports with an increased risk such as football, basketball, gymnastics, ice hockey, and wrestling should have a certified athletic trainer present at every practice and game. Moderate risk sports include: volleyball, track and field, soccer, lacrosse, and field hockey. Sports with moderate risk are recommended to have a certified athletic trainer present at all times, and if not available at all times, should be able to respond within 3-5 minutes. Some of the low risk sports include: baseball, rowing, cross country, fencing, and swimming. The medical coverage requirements for low risk sports are less strict. A first aid responder (someone who is CPR and AED certified), should be present at all times. These recommendations can be related to the injury rates by sport found in other studies.

Many of these specific injury prevention strategies are used in the NCAA intercollegiate setting, however, at the club, intramural and recreational sport levels, these injury prevention strategies may be absent. This is most likely because the NCAA has done the most research into the competition injury trends, and also has the most financial resources to implement prevention strategies. Injury prevention strategies are still very important at the club, intramural, and recreational level, but since there is no national injury database, it is difficult to determine a focus area for injury prevention strategies. Establishing sports injury rates at the collegiate recreational level is one of the first steps in documenting a need for preventative treatment options and medical coverage requirements.

Summary and Rationale

The majority of previous studies have been conducted to record the frequency, type, and mechanism of injuries at the NCAA intercollegiate level to document the need for daily medical treatment options (Hootman, Dick, & Agel, 2007). However, very little research has shown the need for treatment options at the intramural, club, and recreation level. Even though the number of participants is greater at the club, intramural, and recreational levels of competition, the research has been focused primarily on NCAA athletes due to funding and resource priorities. The age range and activities are the same, but some of the other factors such as conditioning, experience, and attitude may impact injury rates when comparing the two groups.

The lack of literature on the injury rates at the club and intramural level of competition may be a factor in the decision about necessary medical coverage. This

research is needed to determine if the total number of injuries and the risk involved requires a universal set of guidelines or requirements for appropriate medical coverage. Information may then be used to provide suggestions for appropriate medical coverage during club, intramural, and recreational sporting activities in the future.

Intercollegiate NCAA, club sport and intramural sport athletes have some common factors needed for comparison including: the same demographic age range and very similar types of activities between levels of competition. Differences in populations will also have an impact on overall risk. The competition level between NCAA and each of the other activity groups will be significantly different. Level of competition may cause a higher injury rate in the NCAA group due to the higher demands placed on athletes during competitions and practices. Another factor that may influence the injury rates between the two groups is the level of conditioning and experience in the NCAA group that may be absent in the recreational, intramural, and club sport groups. In this case, the recreational sport groups may have a higher injury rate because their conditioning and acclimatization to activity may not have been previously established. Therefore, the purpose of this study is to determine how injury rates differ between activity and club sport, intramural sport, and NCAA sport levels of competition in a collegiate setting. To assess varying risks of injury within these populations and activities, three research questions were specifically developed.

Research Question #1: Is there a difference in the type of reported injuries between NCAA and club sports?

Research question #2: Is there a difference in the overall rate of reported injuries between NCAA, club sports and intramural sports?

Research Question #3: Is there a difference in the rate of reported injuries between the same sport at the NCAA and club sport levels?

CHAPTER 3

METHODS

Data Collection

This study examined archived injury reports collected over a two year period for all club sports. IRB approval was sought; however was not required, since all identifying personal information was removed prior to data analysis. Injury information was collected over a two year period from Fall 2012 to Spring 2014 and was examined at a University in the south east. Certified Athletic Trainer SOAP (Subjective, Objective, Assessment, Plan) notes were compiled and examined for club sport injury trends and frequencies. Intramural injury information was collected by using campus recreation incident reports to gain a general idea of the risks involved during intramural sport. To be included in this study, injuries must have occurred during participation in club or intramural activity, must have required medical attention and must have been reported to a certified athletic trainer, and must have limited participation for at least one day following injury. Intramural injuries were included if they were reported to a campus recreation employee, required some form of medical treatment outside of general first aid, limited the athlete's participation for at least one game, and were documented using a campus recreation injury or incident form.

All injury reports were completed by a Certified Athletic Trainer or another associated health care professional using the *Sportsware* or *Point and Click* injury documentation software, or by using an incident report form. Injury reports and information are different for each person documenting an injury, however the standard

injury report typically includes (a) type of injury (e.-g., strain, sprain, fracture, catastrophic injury), (b) body part injured, (c) mechanism of injury (non-contact, player to player contact, etc.), and (d) the activity and location when the injury occurred. Injury and incident reports that were included in the study contained the type of injury, body part injured, and activity. Intramural injuries were documented using campus recreation incident reports and were not typically completed by a health care professional. These incident reports were only used to compare frequencies, and were not analyzed for accuracy or specific injuries since they were not completed by someone with injury documentation experience or training. Data was then compared between sports and levels of competition, as well as with the previous data on NCAA injury rates.

Additional information collected for club sports included the number of player and team interactions within each particular activity. In other words, the number of games and practices each team had, and the number of people who played. The number of sport interactions was then compared to the total number of injuries and used to describe the frequency of injury. This information was collected by examining previously documented club sport field reports and practice summaries. These reports were completed at each club sport event and include what teams used the field, how many athletes were at each practice or game, and any incidents that occurred during the event. This information was used to provide the research team with an accurate estimate of the total number of sport interactions and the total number of participants per activity. The total number of injuries was compared with the number of sport interactions. This resulted in a ratio for every sport with the number of injuries compared to the number of

interactions such as: x amount of injuries for every 1,000 games. Injury ratios for games and practices were then compared to previously established injury rates.

Reliability and Accuracy

Multiple methods were used to increase reliability and accuracy during the data collection and analysis. Only injury reports completed by a certified athletic trainer or team physician were included for club sport injuries, while intramural injuries were only documented for frequency and not accuracy since they were not completed by a trained professional. Injury reports were examined by a second health care professional (either an athletic trainer or team physician) before being included in the study to make sure the standards are met in between documenters. From each injury report, the type of injury, activity, body part, and body area were all recorded in a Microsoft Excel worksheet. Recording accuracy was then verified by having a second researcher examine 10% of the content for accuracy, of which 99% was recorded accurately. This ensured that the information was read and recorded correctly.

Data Analysis

Data was inputted into the SAS (Statistical Analysis System) computer program for analysis. This program allowed the research team to sort variables, categorize data, and run the statistical tests. A difference in two proportions z-test was chosen as the statistical test because it most easily compared unequal sample sizes and injury rates as proportions, and due to the large sample sizes, was appropriate instead of a t-test. The z-test is used as a standardized means of comparison between two independent samples to determine whether two means are significantly different. For this statistical test, the z-

score becomes the test statistic and was calculated using a specific SAS programmed code. The difference in two proportions z-test can also be calculated by hand. A pooled proportion is calculated using the two sample proportions and two sample sizes ($P = p_1 * n_1 + p_2 * n_2) / (n_1 + n_2)$ (Stattrek.com, 2014). The standard error is calculated as ($SE = \text{sqrt}\{ P * (1-P) *[(1/n_1) + (1/n_2)]\}$, while the test statistic is a z-score ($Z = (p_1-p_2) / SE$ (Stattrek.com, 2014).

Research Question #1: Is there a difference in the type of reported injuries between NCAA and club sports?

For this research question, type of injury refers to the body area that is injured. Injuries were categorized as head/neck, upper extremity, trunk/back, lower extremity, or other/system. This allowed the research team to compare club sport injuries to previous literature and injury distributions found in an NCAA population. This research question compares proportions of the total number of injuries between populations, so a difference in two proportions z-test was used for the statistical analysis. Each type, or category, of injury was compared between the groups. For example, club sport and NCAA head/neck, upper extremity, trunk/back, lower extremity, and other injuries were compared using both practice and game injury rates.

The null hypothesis for this question is H_o: $P_1-P_2 = 0$, while the alternative hypothesis is H_A: $P_1-P_2 \neq 0$. If there is a significant difference in the proportions, proportion one minus proportion two would not equal zero. A positive result would indicate the injury rate is greater in proportion one, while a negative result would indicate

the injury rate is greater in the second proportion. The difference in two proportions test uses a pooled sample proportion to calculate the standard error and test statistic.

NCAA injury rates were used for proportion one, while club sport injury rates were used for proportion two. An alpha value of .05 was used as the level of significance in this analysis. A Z-score and p-value were calculated for each type of injury between samples. The z-score represents the test statistic, while the p-value represents the probability of observing a sample statistic as extreme as the test statistic. A p-value less than the level of significance ($\alpha = .05$), suggests we reject the null hypothesis, which in this case means there is a significant difference between the NCAA and club sport rate of injury for certain types of injuries.

The same formula can be used to determine which sample has a greater risk of injury. This would test the hypothesis (H_0: P_1-$P_2 > 0$ H_A: P_1-$P_2 < 0$). Testing whether one proportion is greater than another will result in only one rejection region on the standard normal scale, and is known as a one-tailed test. The z-score remains the same for each comparison; however the end p-value decreases for each case since only one rejection region is used instead of two. A positive z-score indicates proportion one is greater than proportion two, while a negative z-score indicates proportion two is greater than proportion one. No statistical analysis was done for injuries in the "Other" category since no injuries were reported during club sports that fit this category, which resulted in a sample size of zero for this test and made a statistical analysis impossible.

Research question #2: Is there a difference in the rate of reported injuries between NCAA, club sports, and intramural sports?

To compare game and practice injury rates between levels of competition, a difference in proportions z-test was used. This approach was chosen since the sample sizes between the NCAA, club sport and intramural populations were unequal. This test compared injury rates by using an injury event as a proportion of the total athletic exposures. For example, during club sport games, 112 injuries occurred during 6,120 exposures, while during NCAA games, 72,316 injuries occurred during 5,244,088 exposures. This test was used to compare NCAA and club sport games and practices, as well as intramural games.

The null hypothesis for this question is H_o: P_1-$P_2 = 0$, while the alternative hypothesis is H_A: P_1-$P_2 \neq 0$. If there was a significant difference in the proportions, proportion one minus proportion two would not equal zero. A positive result would indicate the injury rate is greater in proportion one, while a negative result would indicate the injury rate is greater in the second proportion.

Research Question #3: Is there a difference in the rate of reported injuries between the same sport at the NCAA and club sport levels?

Previous literature did not provide the number of exposures by sport for the NCAA population, which limited the options for a statistical analysis. NCAA data did include injury rates per 1,000 athletic exposures. This informed the approach for the club sport data analysis. Club sport injuries and exposures were collected for 9 sports (M./W.

Ultimate, M./W. Soccer, M./W. Lacrosse, W. Field Hockey, and M./W. Rugby). NCAA data included information for 15 sports, and within the two samples, 5 sports overlapped.

Game and practice injury rates were collected for the 9 club sports and compared to the 15 previously established rates for the NCAA population. Over the two year period, club sports participants experienced 112 injuries during 6,120 game exposures, while the NCAA sample included 72,316 injuries during 5,244,088 game exposures. Club sports participants suffered 62 injuries during 16,332 practices, while NCAA participants suffered 109,160 injuries during 27,402881 practices.

CHAPTER 4

RESULTS

Research Question #1: Is there a difference in the type of reported injuries between NCAA and club sports?

Research question one compared types of injuries between NCAA and club sports. Each injury was categorized as head/neck, upper extremity, trunk/back, lower extremity, or other based on the body part injured during activity. When comparing injury rates found in table one, club sports had a higher percentage of injuries in the head/neck (15.9%), upper extremity (21.2%), and lower extremity (56.1%) during games than NCAA sports (head /neck: 9.8%, upper extremity: 18.3%, and lower extremity: 53.8%). These injury rates were found to all be significantly different during the statistical analysis shown in table two. Club sports had a lower percentage of injuries categorized as trunk/back (6.8%) than NCAA (13.2%); however, the statistical test was unable to say there was a difference in proportions. Using these statistics, we can say the club sports participants are more likely to suffer a head/neck, upper extremity, or lower extremity injury during games than an NCAA participant.

For practice injury rates, the same analysis was performed to compare injury rates between populations for specific injuries. Practice injury rates were higher for trunk/back (15.2%) and lower extremity (66.1%) injuries in club sports participants than in NCAA participants (trunk/back: 10%, lower extremity: 53.7%). Head/neck and upper extremity injuries during practice were both a smaller percentage of injuries in club sports participants than in NCAA participants; however, no significant differences were found

between the two groups. Using a one-tailed statistical analysis tests the hypothesis that club injuries are more likely to occur than NCAA injuries. In table 3, since the test statistic (z-score) was negative, the second proportion (club sports), is greater, which is confirmed because the p-value is less than the level of significance. This study suggests club sport participants are more at risk to suffer a trunk/back or lower extremity injury during a practice than an NCAA athlete.

Table 1

Percentage of club and NCAA injuries by body area.

Club Sport Injury Distribution			**NCAA Injury Distribution**	
	Games	**Practices**	**Games**	**Practices**
Head/Neck	15.9%	7.1%	9.8%	12.8%
Upper Extremity	21.2%	11.6%	18.3%	21.4%
Trunk/Back	6.8%	15.2%	13.2%	10%
Lower Extremity	56.1%	66.1%	53.8%	53.7%
Other	0.00%	0.00%	4.9%	2.2%

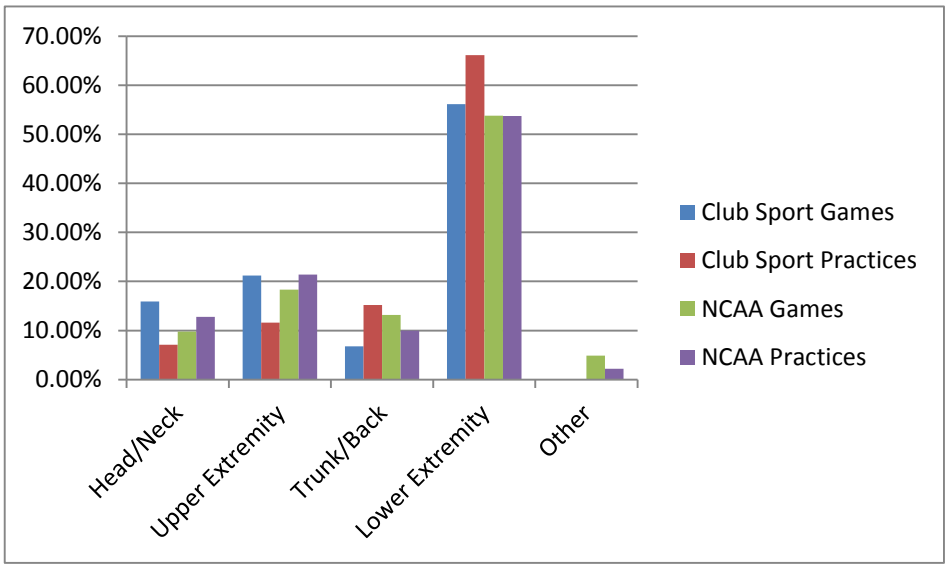

Figure 1 Percentage of club sport and NCAA game and practice injuries by body area (Hootman, Dick, & Agel, 2007). This graph represents the percentage of all injuries suffered during games and practices for NCAA and club sport participants by body area.

Table 2

NCAA and club sport game injury rate statistics by body area.

Game Injury Rates	Pooled Proportion	Z-Score	Two Tail P-Value	One-Tail P-Value
Head/Neck	0.0013	-4.422	<.0001	<.0001*
Upper Extremity	0.0025	-3.195	0.0013	.00069*
Trunk/Back	0.0018	0.6415	0.5211	.261
Lower Extremity	0.0074	-4.255	<.0001	<.0001*

*Asterisk indicates a significant difference between samples.

Table 3

NCAA and club sport practice injury rate statistics by body area. Asterisk indicates a significant difference between samples.

Practice Injury Rates	Pooled Proportion	Z-Score	Two-Tail P-Value	One-Tail P-Value
Head/Neck	0.0005	0.1134	0.9097	-
Upper Extremity	0.0008	0.2472	0.8047	-
Trunk/Back	0.0003	-4.111	<.0001	<.0001*
Lower Extremity	0.0021	-6.611	<.0001	<.0001*

*Asterisk indicates a significant difference between samples.

Research question #2: Is there a difference in the rate of reported injuries between NCAA, club sports, and intramural sports?

Research question two compared overall injury rates between NCAA, club sports, and intramural sports. Game injury rates were available for all levels of competition, while only NCAA and club sports had a practice injury rate, since intramural teams do not practice. NCAA injury rates were used from a previous study that collected data over a 16 year period for 15 varsity sports. Club sport injury rates were collected at a single university for 9 sports over a two year period, while intramural injury rates were collected at the same university using campus recreation injury reports for 8 sports over a two year period.

Injury rates were compared between levels of competition at the game and practice level. The game injury rate for club sports found in table 4 (18.3 injuries/ 1,000 athletic exposures) was found to be significantly greater than both NCAA (13.79 injuries/ 1,000 athletic exposures)(Hootman, Dick, & Agel, 2007) and intramural sports (10.28 injuries/ 1,000 athletic exposures). The game injury rate for NCAA sports was also found

to be significantly greater than the intramural rate of injury. Practice injury rates were compared between NCAA (3.98 injuries/ 1,000 athletic exposures) (Hootman, Dick, & Agel, 2007) and club sports (3.8 injuries/ 1,000 athletic exposures); however, there was no significant difference between the two levels of competition.

Table 4

Overall NCAA, club sport, and intramural sport injury rates per 1,000 athletic exposures.

NCAA and Club Sport Injury Rates			
	Exposures	**Injuries**	**Injury Rate**
NCAA Games	5244088	72316	13.79
NCAA Practices	27402881	109160	3.98
NCAA Overall	32646969	181476	5.56
Club Sport Games	6120	112	18.3
Club Sport Practices	16332	62	3.8
Club Sport Overall	22452	174	7.75
Intramural Games	52434	539	10.28

NCAA injury rates were used for proportion 1, while club sport injury rates were used for proportion two. The Z-score when comparing NCAA and club sport games found in table 5 was -3.0235, and since the z-score is the test statistic, the p-value (0.00249), represents the probability of observing a sample statistic as extreme as the test statistic. A p-value less than the level of significance ($\alpha = .05$), suggests we reject the null hypothesis, which in this case means there is a significant difference between the NCAA and club sport injury rate. The same formula is used for a one-tailed test to determine which sample has a greater risk of injury. The z-score (-3.0235) remains the same, however the p-value changes to .00126, which is still less than the level of significance.

Since the z-score is negative, proportion 2 is greater, which indicates club sports has a significantly greater rate of injury during games than NCAA competition.

Game injury rates were also available for intramural sports using campus recreation incident and injury report forms. This provided the total number of injuries that occurred during intramural participation. Five hundred and thirty nine injuries occurred during 52,434 exposures which resulted in an injury rate of 10.28 injuries per 1,000 exposures. When compared with NCAA and club sport injury rates, intramural sport injury rates were significantly different than both NCAA and club sport injury rates. Two separate z-tests were run with NCAA and club sports both being used as P_1 and intramural sports as P_2 in each case. For NCAA test statistic was a z-score of 6.867, while the club sport comparison resulted in a z-score of 5.663. Both of these test statistics confirmed proportion one was significantly greater. The P-value for both tests was less than .0001, which was less than the level of significance.

Practice injury rates were also compared between the two groups; however the null hypothesis was not rejected. The p-value (.704) is greater than the level of significance, so with our samples, we cannot conclude that there is a difference in the rates of injury during practices.

Table 5

Overall NCAA, club sport, and intramural sport game and practice rate statistics.

	Pooled Proportion	Z-Score	P-Value
NCAA vs Club Sport Games	0.13755253	-3.0235	0.00249*
NCAA vs Club Sport Practices	0.003983411	0.3798	0.704
NCAA vs Intramural Games	0.013755253	6.867	<.0001*
Club Sport vs Intramural Games	0.011117942	5.663	<.0001*

*Asterisk indicates a significant difference between samples.

Research Question #3: Is there a difference in the rate of reported injuries between the same sport at the NCAA and club sport levels?

Research question three compared specific sport injury rates between levels of competition. Without the specific exposure numbers by sport it was impossible to do a statistical analysis; however, data can still be used as a reference just based on injury rates. This question was again broken down into practice and game injury rates by sport.

Injury rates compared between club sports and NCAA sport games (table 6) were similar for men's lacrosse (12.6 and 15.25), women's lacrosse (7.2 and 5.63), men's soccer (18.8 and 13.18) and women's soccer (16.4 and 11.06). No injuries were documented during women's field hockey games at the club level, which is noticeably different than the 7.9 injuries per 1,000 exposures found in the NCAA population. This may be attributed to a smaller sample size for this sport, or due to a fewer number of home events with athletic training coverage. Injuries were documented the same for field hockey, and athletic training coverage was provided at all home events.

Club sport exclusive sports varied within the injury rate range. Men's ultimate frisbee had the lowest injury rate at only 1.34 injuries/1,000 athletic exposures. Women's ultimate frisbee had an injury rate of 9.15 injuries/1,000 athletic exposures, and was closest to women's field hockey and men's basketball in terms of risk. Men's and women's rugby had the two highest injury rates of all NCAA and club sports. Men's rugby had the most exposures and the most total injuries for all club sports, which resulted in an injury rate of 36.42 injuries per 1,000 exposures, and was even higher than men's football at 35.9. Women's rugby had a smaller sample size, but by far the highest rate of injury during games at 52.63 injuries per 1,000 exposures. With injury rates higher than men's football, the risk of injury during men's and women's club rugby suggests a need for medical treatment options for these athletes.

Table 6

NCAA and Club Sport Game Injury Rates per 1,000 Athletic Exposures.

Game Injury Rates		
Sport	**NCAA**	**Club Sport**
Men's Ultimate		1.34
Softball	4.3	
W. Volleyball	4.6	
Baseball	5.8	
W. Lacrosse	7.2	5.63
W. Basketball	7.7	
W. Field Hockey	7.9	0
W. Ultimate		9.15
M. Basketball	9.9	
M. Lacrosse	12.6	15.25
W. Ice Hockey	12.6	
W. Gymnastics	15.2	
M. Ice Hockey	16.3	
W. Soccer	16.4	11.06
M. Soccer	18.8	13.18
M. Wrestling	26.4	
M. Football	35.9	
M. Rugby		36.42
W. Rugby		52.63

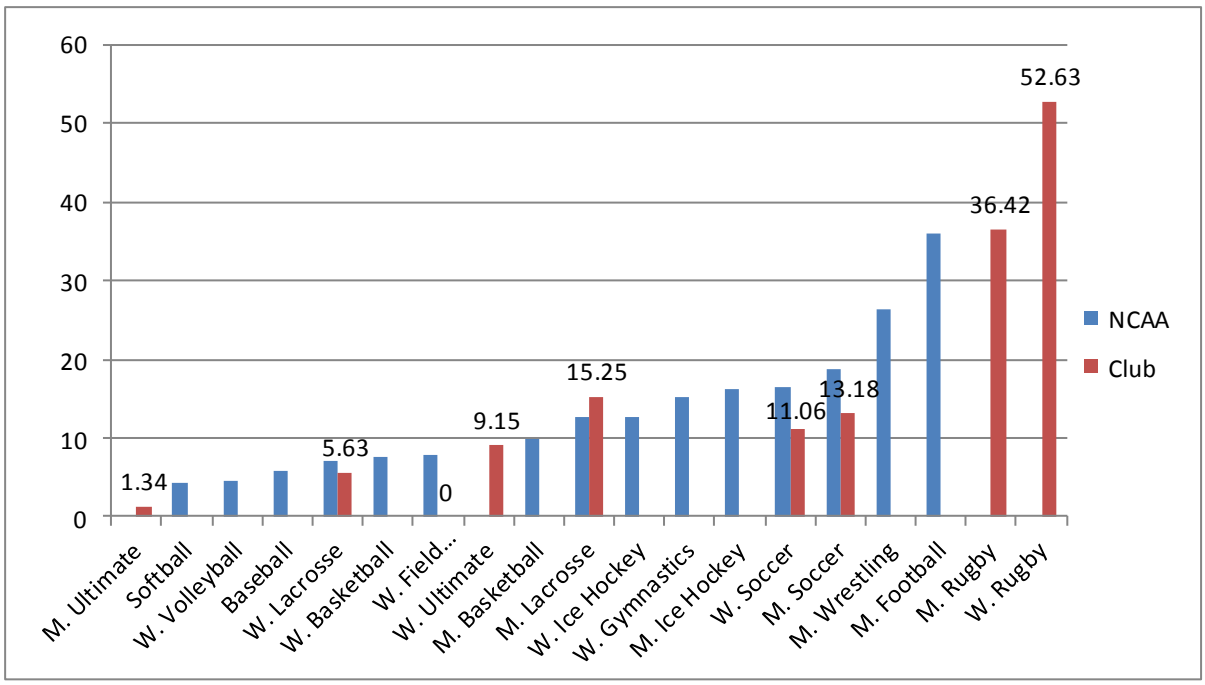

Figure 2 NCAA and Club Sport Game Injury Rates per 1,000 Athletic Exposures.

The practice injury rates found in table 7 were calculated using the total number of practices exposures and injuries by sport. Over 16,000 total exposures were documented for the 9 club sports. In general, fewer injuries occurred during practices than in games, similar to what was found in the NCAA injury sample. Men's soccer decreased from a game injury rate of 13.18 to a practice injury rate of 8.03, however the practice injury rate of 8.03 was still almost double the injury rate found in NCAA men's soccer of 4.3. Men's club rugby had the highest injury rate of all sports at 7.97 injuries per 1,000 exposures.

Table 7

NCAA and Club Sport Practice Injury Rates per 1,000 Athletic Exposures.

Practice Injury Rates		
Sport	**NCAA**	**Club Sport**
Men's Ultimate		0.44
Baseball	1.9	
M. Ice Hockey	2	
W. Ice Hockey	2.5	
W. Ultimate		2.58
Softball	2.7	
M. Lacrosse	3.2	0.31
W. Lacrosse	3.3	1.15
W. Field Hockey	3.7	3.57
M. Football	3.8	
W. Basketball	4	
W. Volleyball	4.1	
M. Basketball	4.3	
W. Rugby		4.3
M. Soccer	4.3	8.03
W. Soccer	5.2	2.99
M. Wrestling	5.7	
W. Gymnastics	6.1	
M. Rugby		7.97

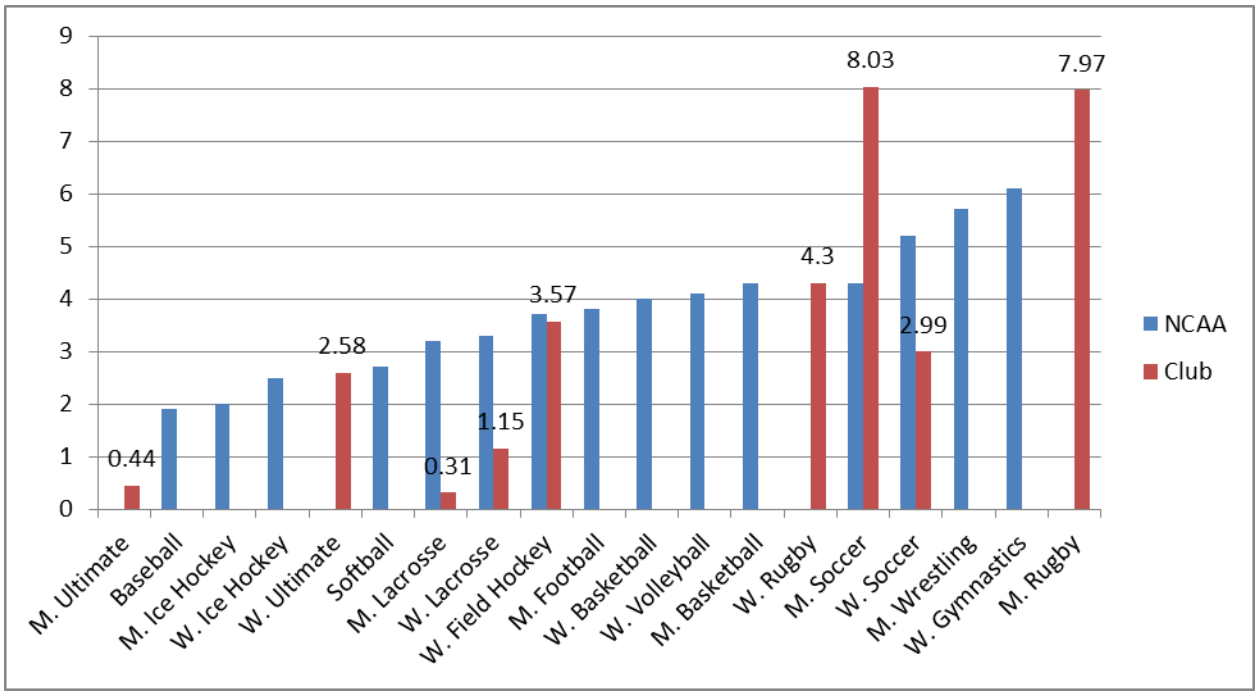

Figure 3 NCAA and Club Sport Practice Injury Rates per 1,000 Athletic Exposures.

CHAPTER 5

DISCUSSION

Research Question #1: Is there a difference in the type of reported injuries between NCAA and club sports?

The increase in specific practice and game injury rates for club sport athletes compared to NCAA athletes helps describe the demands placed on this population during competition, and their ability to handle these challenges. The sport rules and regulations are exactly the same between club sport and NCAA competitions; however the conditioning and ability are very different between the two populations. Student run club sports and athletes are participating in demanding physical activity, without the structured conditioning and training implemented at the NCAA level of competition. This puts them at a higher risk of injury when participating in physically demanding activities.

The literature review found that campus recreation directors reported only 55% of club sports had a paid or volunteer coach and only 35% had access to a certified athletic trainer within their institution (Schneider, Stier, Kampf, Gaskins, & Haines, 2008). Within this study's sample, only two club sport teams had paid coaches, while the rest were student led. The increased risk of lower extremity, upper extremity, head/neck, and trunk/back injuries found in the club sport sample suggests that this population was not being trained adequately to handle sport demands, especially during games. This is possibly related to the lack of adult supervision and training regimen in place for these athletes. An increase in the number of adult coaches and strength and conditioning specialists at the club sport level would likely decrease the number of injuries seen within

this population for multiple reasons including: improved coaching methods and techniques, more qualified and educated conditioning specialists, an increase in safety education for players, and a more structured conditioning program. However, very few campus recreation and club sport programs have the option to change their organizational structure so dramatically, so it is important for all groups involved to be aware of the risks involved in club sport participation, as well as the potential areas of liability. This includes the university, campus recreation professional staff, sports medicine and risk management staff, and club sport athletes.

Research question #2: Is there a difference in the rate of reported injuries between NCAA, club sports, and intramural sports?

The overall injury rates may be impacted by the intensity of the activity, the level of competition, and the participant ability (Hootman,Dick, & Agel, 2007). For example, intramural sports have the lowest level of competition and intensity, and were found to have the lowest rate of injury during games. NCAA athletes compete at a high level of competition and intensity; however, these athletes are the most prepared and skilled. They had a higher risk of injury than intramural participants, but were lower than club sport participants. Club sports participants were found to have the highest risk of injury during games in this study. This would suggest that even though they compete at the intermediate level of competition, club sport athletes may have less ability or conditioning, or that the intensity during club sport games is greater. During practices, intensity decreases for both NCAA and club sports, which gives us a better idea of how athlete ability and level of competition affect injury rate (Hootman, Dick, & Agel, 2007).

Since the injury rates during practices were not significantly different, the intensity of the activity may be an important variable when assessing risk during competitive sports.

Research Question #3: Is there a difference in the rate of reported injuries between the same sport at the NCAA and club sport levels?

In this study, the majority of the club sports had a higher rate of injury during games than during practices. This included men's ultimate, lacrosse, soccer, rugby, and women's lacrosse, ultimate, soccer, and rugby. This is typically what was seen in the previous literature with NCAA injury rates. During games, players normally compete at a higher level than during practices, the speed of play may be greater, and in higher risk sports such as football or rugby, the physicality may increase.

When compared with NCAA sports in tables 6 and 7, the injury rates can become very valuable and provide a direction for injury treatment methods. Men's ultimate Frisbee had the lowest injury rate (1.34 for games and 0.44 during practices) during both practices and games over all club and NCAA sports. Club men's and women's lacrosse, and men's and women's soccer all had a similar game injury rate when compared with NCAA. These trends were fairly consistent during practices as well, although club sports seemed to have lower practice injury rates in general than NCAA. Men's club soccer actually had the highest practice injury rate, which may show an increased risk at club soccer compared to NCAA soccer, or it may be impacted by a smaller sample size and fewer exposures.

Men's and women's club rugby were the two most dangerous club sports, and even had a higher reported injury rate than that found in NCAA football. The game injury rate for

men's rugby was 36.42 injuries per 1,000 athletic exposures, 35.9 for men's football, and 52.63 for women's rugby. Men's football at the collegiate level has the highest rate of injury during games, and is required to have the most medical coverage including a team physician, athletic trainer, and EMS on site during games (NATA, 2007). Currently, USA Rugby, the governing body for all collegiate rugby competitions, only requires the home team to provide an athletic trainer during games. The rate of injury found in this study suggests the need for additional medical coverage for these high risk sports. When compared to the necessary medical coverage requirements for NCAA sports, club sport medical coverage is minimal. If men's and women's rugby were governed by the NCAA, each program would be required to have their own certified athletic trainer, and would be placed in the high risk category. Campus recreation programs that support men's and women's rugby programs should be aware of the high rates of injury, and the risk involved, before allowing these teams to compete.

Practical Application

Recognizing and documenting the risks involved in sport participation is the first step in creating a safer environment for participants. At the varsity level of competition, sport injury rates were used to document the need for medical care and coverage at sporting events. The recognized risks of sports injury warranted immediate care options for participants. Similar rates of injury at club sport and intramural sport levels of competition should also convey a need for medical coverage at these events. This is especially true when the number of participants in club and intramural sports is greater

than the number of participants at the NCAA level, and when a negative experience can impact the student athlete outside of sport participation.

As stated previously in the literature review, participation in campus recreation sports programs can provide many positive outcomes for students including increased overall GPA and student retention (Huesman, Brown, Lee, Kellogg, & Radcliffe, 2009) (Gibbison, Henry, & Perkins-Brown, 2011). With over 5 million students regularly participating in campus recreation programs (NIRSA, 2005) and over 2 million students participating in club sport (Pennington, 2008), it is essential for these students to continue to have these opportunities for physical activity through sport. These outcomes are valuable for both students and universities, and the prevalence of sports injuries in intramural and club sport programs can reduce these benefits. If the intramural injury rate found in this study (10.28 injuries/1,000 exposures) was applied to the entire population, we would expect to see over 50,000 injuries annually, if each athlete only participated once. Many students participate in more than one intramural activity each week, which would significantly increase the total number of injuries. The same can be said for club sport participants. Over 2 million athletes participate annually, and using the overall injury rate (7.75 injuries/1,000 exposures), if we estimate between 50-100 exposures per year for each athlete, which is similar to the sample exposures collected in this study, we would expect to see between 750,000 and 1.5 million injuries per year. This number of injuries could significantly reduce the positive benefits received for the student athlete and university.

In this study, men's and women's rugby had the highest rate of injury during games, followed by men's lacrosse and soccer, and women's soccer. In almost every sport, the rate of injury at games was higher than the rate of injury at practices. This information can be used practically when deciding which sport events need medical coverage, or which events should be prioritized for medical coverage. This would be very similar to how the NATA (2007) created guidelines and recommendations for medical coverage at NCAA events. In this case, the low rate of injury found during men's ultimate Frisbee suggests that this sport only needs supervision by someone who is first aid certified. Medium risk sports would require athletic trainer's supervision at games and might include men's lacrosse and soccer, and women's soccer. Men's and women's rugby would be the highest risk club sports and would need athletic training coverage at all times, and possibly additional medical supervision for games similar to the recommendations for medical coverage at NCAA football games. Since many universities are only able to staff one home event at a time, it is important to recognize what athletes are the most at risk during competition.

Men's and women's rugby in particular need more medical coverage. Ignoring these high risk sports, or only providing the necessary minimum amount of medical coverage, can create a negative experience for participants, or even push student athletes away from physical activity through sport. These club sport events should not be hosted without an organized administrative staff, coaching staff, proper conditioning program, and strategic plan in place to handle sport injuries. At the club sport level, where most teams are student run, this might involve team presidents or club sport directors

becoming more involved in creating a schedule which includes a gradual progression into activity for all athletes. This would help prepare and condition athletes more appropriately for the demands of the sport, and reduce the risk of injury.

Future Research

This area of research has huge potential for growth in the future, mostly due to the fact that the amount research on club and intramural sport injury rates is so limited to date. Very few universities have athletic training or medical staff employed to cover home club sports and intramural events. One of the first steps for future research would be to identify similar athletic training programs at Division I universities that provide medical coverage for these programs. Collaboration with multiple athletic training or campus recreation programs has the potential to increase the sample size and provide a more accurate measurement of injury rates. A good start would be to compare all the universities within a specific conference such as the Atlantic Coast Conference (ACC).

Collaboration with multiple universities may also provide more accurate information on sporting events not currently covered by an athletic trainer at this university. For example, since intramural sports are not covered by an athletic trainer at the researched institution, the majority of their injuries were not evaluated by a health care professional. Injury and incident reports were filled out by student employees who only have basic first aid training and are not prepared to diagnose or treat anything more than a minor injury. The intramural sport level of competition would be an interesting topic for future study because the number of participants is so high. New intramural

activities and opportunities are always being incorporated into campus recreation programs as well, which can create positive and negative consequences for the activity.

Another potential area for future research is to look at injury rates for club sports or intramural sports that do not have an athletic training program or trained medical staff at their events. This would include the majority of collegiate recreation programs. How injury and incident rates vary between universities with different amounts of medical coverage will influence how risks are taken into consideration. This could also possibly include gathering information from campus health centers instead of through a campus recreation department. While this may not account for every minor injury that occurs at events, it may provide a better picture of the injuries that require hospitalization or further care following injury. This would also be the first step in tracking how medical personnel impact the recurrence rate of future injuries.

Lastly, there will always be the opportunity for future research into the causes of each injury by sport including participant ability, sport demands and intensity, and level of competition. Data collected within this project could also be examined for specific injury frequencies, such as the number of ankle sprains by sport. It would also be interesting to compare the number of injuries suffered during different points in the school year such as during the first week of club sport practices or during exam week. Increased injury rates during the first week of club sport practices may be attributed to a lack of conditioning or the athlete not being prepared for the demands of the sport, similar to injuries observed during a preseason phase of the season. These injuries might be reduced by a more regimented, gradual increase into activity, which many club sport

programs do not typically practice. There is also the possibility that injury rates can be impacted by outside influences and environmental factors such as the added stress many students face during exam week. Many factors can influence on the field performance and risks, many of which are very difficult to account for and measure, but can always be explored in the future.

Limitations

One of the limitations of this study is that not all injuries can be accounted for due to multiple reasons. Injury reports are dependent on the student athlete being proactive and seeking medical attention for an injury that may go unnoticed if it is not brought up. Injuries may also occur at an away event or an injury may initially be documented by an outside physician or hospital. Therefore, the number of injuries documented in this study may actually be lower than the true number of injuries that occur during sporting activities. Every effort has been made to document each injury, but it is not possible for every injury to be captured. This may or may not have an impact on the final results, depending on the number of injuries and catastrophic injuries treated by an outside source. Injury reports must also be completed by a health care professional to be included and credible in this study. Reports completed by a non-health care professional cannot be included because they have a greater chance of being inaccurately completed.

Another limitation is that this study was only able to obtain a sample from a single university. Campus recreation departments and the programs they offer vary between universities and location, so this information may not be a true representation of all club and intramural sport programs. A sample size from multiple universities may

have provided a wider range of injury information, and can potentially be used as a future research project.

Conclusions

Only a fraction of collegiate athletes compete at the varsity level, while the majority of student athletes participate in club sports or intramural sports. Previously, the only established injury rates for these levels of competition were found at the NCAA level. This left a majority of the active sport population at the University level with an incomplete picture of the true risk involved when playing a club or intramural sport. This study found significant differences in injury rates when comparing club sports and NCAA sports. In fact, club sports participants were found to be more at risk of suffering an injury overall, as well as suffering a head, neck, upper extremity or lower extremity injury during games, and a trunk, back, or lower extremity injury during practices than NCAA participants. This information is concerning since the club sport population is much greater, and the amount of resources to handle injuries at this level is much less.

The need for improvements in medical care at the club sport level is evident, and with future research, possibly at the intramural level as well. The rates of injury found in this study show that club sports need to be treated as seriously as varsity competitions when it comes to handling risks. Using and comparing club sport injury rates to NCAA injury rates and standards of care can provide a great starting point for establishing a plan of care for club sport programs. To make club sport events more successful, this may include more student safety officers for club sports, more athletic trainers, or an increased priority for collaboration with physicians, health centers, and EMS teams. Most

importantly, regardless of the level of competition, each student athlete should be provided the best opportunity for continued medical care during sport competition.

APPENDICES

Appendix A

Figure 4.1 Sample Injury Reporting Form

CLEMSON UNIVERSITY
DEPARTMENT OF CAMPUS RECREATION
ACCIDENT/INJURY/ILLNESS REPORT

Report Data | DATE: _____ Time of Injury: _____ am/pm Time Notified: _____ am/pm

Personal Data | NAME OF INJURED: _____ ☐ FEMALE ☐ MALE AGE: ____

CLASSIFICATION: ☐ Student ☐ Faculty ☐ Staff ☐ Community Member ☐ Other _____

If Student/Faculty/Staff, CU ID #: _____ If Community Member, ID #: _____

Address: _____ PHONE: _____
EMAIL: _____

Family Contact: _____ Phone: _____

Activity Data | ☐ Aquatics ☐ Club Sport ☐ Fitness ☐ Intramurals ☐ Climbing Wall ☐ Leisure Skills Class ☐ Informal

SPECIFY: Aquatic Activity _____ Club Sport _____ Fitness Activity _____
Intramural Activity _____ Open Rec. Activity _____ Special Event _____

LOCATION of the Activity (Indicate the room or activity area in Fike or outdoor venue. If off campus, city, college/university):
_____

Injury Data | BODY FLUID SPILL? ☐ Yes ☐ No Description: _____

NATURE OF POSSIBLE INJURY

- ☐ Concussion Other _____
- ☐ Contusion
- ☐ Dislocation
- ☐ Fracture
- ☐ Laceration
- ☐ Sprain

PART OF BODY INJURED

	R	L		R	L		R	L	
☐ Abdomen	☐	☐	Ankle	☐	☐	Hand	☐	☐	Shoulder
☐ Back	☐	☐	Elbow	☐	☐	Hamstring	☐	☐	Toe
☐ Face	☐	☐	Finger	☐	☐	Knee	☐	☐	Upper Arm
☐ Head	☐	☐	Feet	☐	☐	Lower Leg	☐	☐	Upper Leg
☐ Neck	☐	☐	Forearm	☐	☐	Pelvis	☐	☐	Wrist
☐ Chest	☐	☐	Groin	☐	☐	Ribs	☐	☐	Other
☐ Other									

Brief Description of Accident/Illness: (Include actions that contributed to the accident. Use reverse side if necessary) _____

_____

_____

_____

Actions Taken | ☐ First Aid Police Contacted: ☐ Yes ☐ No EMS Contacted: ☐ Yes ☐ No
Call Time: _____ Arrival Time: _____ Call Time: _____ Arrival Time: _____

Did the injured refuse attention? ☐ Yes ☐ No If yes, what reason was given _____
Description of care provided: _____

Was there a follow-up recommendation? ☐ Yes ☐ No If yes, made by whom? _____
Indicate recommendation: _____

Was transportation provided? ☐ Yes ☐ No Mode of Transportation: ☐ Ambulance ☐ Private Vehicle ☐ Public Safety Vehicle
Name and Location of Medical Facility: _____

REPORT PREPARED BY (print): _____ Title: _____ Phone: _____

SIGNATURE: _____ Date: _____

I have read the above report thoroughly and attest that all information is correct to the best of my recollection.

SIGNATURE OF INJURED: _____ DATE: _____

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