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Interactive Qualification Project: Sports Related Injuries

An Interactive Qualifying Project submitted to the Faculty of the Worcester Polytechnic Institute in partial fulfillment of the requirements for the Bachelor's Degree of Science

By:

Angelo Chandler

John Bray

Kene Mgbojikwe

Approved By:

Jill Rulfs

Mike Desavage

Sarah Carver

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Abstract

As athletics on the collegiate level become more competitive, the need for professionally trained strength and conditioning coaches increases. Having qualified coaches enhances athletes' performance on the field, and have been shown to promote safety and prevent certain injuries. Organized injury databases are needed to support these athletic professionals in their quest to help prevent injuries. With the knowledge of sports medicine growing every day, it is important to have strength and conditioning coaches.

Acknowledgments

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Authorship Page

Our project team, consisting of Angelo Chandler, John Bray, and Kene Mgbojikwe, united our strengths and abilities throughout this project. Our IQP is dynamic and entices further studies on NEWMAC Sports Related Injuries. All tasks were distributed evenly in the completion of '07 Interactive Qualifying Project, "Sports Related Injuries".

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Injury Prone College Sports Athletics

With each athletic season comes a new group of college athletes. Each seasonal sport is known specifically for the skill and physical intensity required. Depending on the nature and physicality of the sport, the amount and type of injuries will vary. Collegiate sports that regularly have a low injury volume were neglected.

Fall Sports

Two common fall sports in NEWMAC colleges and universities are football and soccer.

Football

The object of football is to score points by advancing the football into the opposing team's end zone. The ball can be advanced by carrying it, throwing it, or by handing it from one teammate to the other. Points can be scored in a variety of ways, including carrying the ball over the goal line, throwing the ball to another player past the goal line or kicking it through the goal posts on the opposing side. The winner is the team with the most points when the time expires and the last play ends.

Football is a highly intense and extremely physical fall sport. It is inevitable that some injuries will occur in this rigorous sport. However, there are measures and precautions that can be taken to reduce the risk of injury occurrence. If an injury were to occur, it is important to minimize the severity of the injury. These precautions primarily need to be done by the athletes, the coaches, and the strength and conditioning coaches on the field.

Primarily, a pre-participation physical evaluation should be performed on every athlete before they even step onto the field. Every athlete should receive a pre-

participation physical evaluation (PPE) to detect conditions which could make playing football life-threatening or disabling. They also are used to detect medical or musculoskeletal conditions that could predispose an athlete to injury or illness during practice or competition. The evaluation should include both a medical history and physical examination. The PPE should be performed by a physician, physician assistant, or medical practitioner with the training and medical skills to recognize heart disease and orthopedic conditions of concern for football. The examination should focus on neck strength, joint range of motion, flexibility, anatomical misalignments and muscle-tendon imbalances. Documentation/re-examination of past neurological, bone and joint injuries should also be looked at. Performing the evaluation at least six weeks prior to pre-season practice and with proper documentation, would allow time for correction or rehabilitation of identified problems.¹⁰

Before stepping out on the field, an athlete should also have basic position knowledge and basic skill development to prevent injury. Before playing football, each athlete should have mastered a basic set of information and skills. At a minimum, athletes should understand the rules of football related to injury prevention and should master the proper execution of the fundamental football skills, particularly blocking and tackling without using the head.

The coach has an overall responsibility for the safety of the athletes, including teaching safety principles to them; overseeing proper selection, fitting and maintenance of equipment, and seeing that they are properly conditioned. Requiring proper warm-up, teaching appropriate techniques, and preventing players from competing beyond their fatigue level is also a coach's responsibility. The coach should be certified in first aid and

CPR, and should attend state-approved in-service training on coaching football. The coach should have a thorough mastery of the rules of football.

Each institution responsible for football competitions should identify a physical trainer and strength & conditioning coach with first aid training whose roles are to develop an injury prevention program, work with injuries and develop a conditioning program. These persons should be present at all practices and all games. These roles are best accomplished by athletic trainers who are certified by the National Athletic Trainers Association (NATA).

In addition to the brief list of responsibilities listed above many other aspects should be taken into account to prevent injuries: Precautions for extreme weather, proper drug/medication usage, proper documentation of injuries, emergency preparations, and proper equipment and facilities. In conclusion, we understand injuries do happen, but the rate of injuries can be dramatically decreased with a proper athletics staff, proper athletic education in the sport basics, and education in how to prevent injuries. The rate of severe injuries can be decreased dramatically in NEWMAC athletics.

Soccer

Soccer is a ball game that is played on a rectangular grass field with a goal at each end of the field. The object of the game is to score by maneuvering the ball, primarily with your feet, into the opposing goal; only the goalkeepers may use their hands or arms to propel the ball in general play. The team that scores the most goals by the end of the match wins.

Soccer is a sport with injuries prone to sudden stops, leg/shin injuries, and head injuries. Soccer injuries are generally defined as either cumulative (overuse) or acute

(traumatic) injuries. Overuse injuries occur over time due to stress on the muscles, joints and soft tissues without proper time for healing. They begin as a small ache or pain, and can grow into a devastating injury if they aren't treated early. Acute or traumatic injuries occur due to a sudden force or impact and can be quite dramatic.

Many injuries can occur in soccer due to the intensity of the sport and due to only having shin guards as protective equipment. The most common of all soccer injuries is an ankle injury. The most common of these is the sprain which occurs when there is a stretching and tearing of ligaments surrounding the ankle joint. The next most common injury is in the knee. In soccer the tearing of the anterior cruciate ligament (ACL) and the posterior cruciate ligament (PCL) happens often. These ligaments work together to provide stability in the knee and cross each other to form an 'X.' The anterior cruciate ligament is most often stretched or torn by a sudden twisting motion while the foot remains planted. The posterior cruciate ligament is most often injured by a direct impact. For a complete tear of the ACL an expensive arthroscopic surgery, has to usually be performed. The final most common injury is a concussion. A concussion may result from a fall in which the head strikes against an object or a moving object strikes the head. A suddenly induced turning movement such as a blow that twists the head is more likely to produce unconsciousness. However, significant jarring in any direction can produce unconsciousness. Typical bleeding into the brain can occur with any blow to the head, whether or not unconsciousness occurs.¹⁰

Hydration, proper education on warm up techniques, and also adequate recovery time after practices and game play are essential to keeping an athlete's body in proper shape. Soccer injuries occur sometimes, and people assume 'everything will be alright',

but in reality as they continue to play they are worsening the situation. Trainers and coaches have to take note of these injuries and allow adequate time for their athletes to heal. In conclusion, soccer is prone to many injuries in addition to the ones listed above, but without proper attention and care, these injuries will worsen and can cause permanent, life long damage.

Winter Sports

Two common winter sports in NEWMAC colleges and universities are basketball and wrestling.

Basketball

Basketball is a sport in which two teams, five players each, try to score points on one another by throwing a ball through a basket under organized rules. Points are scored by shooting the ball through the hoop from the top, the team with more points at the end of the game wins. The ball can be advanced on the court by dribbling or passing it between teammates. Disruptive physical contact, known as fouls, is not permitted and is subject to penalty from referees.¹⁵

Since this sport seems to be straight forward and safely regulated by referees reducing rough play, one would expect that the amount of injuries in this sport to be minimal if not non-existent; however basketball is a very injury prone sport. Basketball injuries can be separated into two general categories: overuse injuries and traumatic injuries.⁷

Overuse Injuries:

Overuse injuries are injuries caused by stressing an area over and over until it is damaged and begins to hurt. One overuse injury common in basketball is known as the

"jumper's knee." This injury is patellar tendonitis and is experienced as pain in the tendon just below the kneecap and it arises when the tendon and the tissues that surround it become inflamed and irritated. The patellar tendon connects the kneecap, the patella, to the shin bone. This is part of the 'extensor mechanism' of the knee, and together with the quadriceps muscle and the quadriceps tendon, these structures allow your knee to straighten out, and provide strength for this motion.¹

Another injury that basketball players experience involves the overuse of the tendons in their shoulders. The tendons that attach muscles to the shoulder bones can become inflamed and painful, particularly when you do repetitive overhead activities, such as shooting the basketball.

Traumatic Injuries:

Traumatic injuries are injuries caused by a sudden forceful movement. An example of a common traumatic injury in basketball is a jammed finger. The severity of this injury can range from a minor injury of the ligaments to a broken finger. The most common type of traumatic injury in basket ball involves a muscle pull or tear. In basketball players, these injuries occur primarily in the large muscles of the legs.

An example of this, and a very common one for basketball players, is an ankle sprain. This injury tends to occur when a player lands, either on the ground or on another player's foot, and the ankle rolls too far outward. When this happens, the ligaments connecting bones and supporting the ankle are stretched, sometimes even torn partially or completely.

Another most serious traumatic injury in basketball is done to the knee. One type of knee injury is a sprain. Knee sprains are small tears in the ligament around the knee that is not severe enough to cause your knee to give way. A more severe injury is a complete tear of one or more of the ligaments that support the knee. The anterior cruciate ligament, ACL, is a commonly torn ligament in the knee. It connects the upper and lower leg bones and helps hold the knee in its place. If damaged the knee will most likely hurt and give way persistently.

Basketball is a sport that is played by all ages and skill levels. It is used both recreationally and competitively. If not careful any injuries caused by overuse or trauma can occur.

Wrestling

Wrestling is a sport in which there is physical engagement between two competitors who are competing for a physical advantage over the other. Although there are many forms of the sport, the one common in the colligate setting is grappling or submission wrestling. This form of wrestling refers to the gripping, handling and controlling of an opponent without the use of striking. It is typically performed through the application of various grappling holds and counters to various hold attempts. Grappling can be used in both a standing position and on the ground. Physical techniques which embody the style of wrestling are clinching, holding, locking, and leverage.¹⁵

Parts of the body prone to injury in wrestling are legs and feet. An injury to ligaments and cartilage of the knee occurs. Prepatellar bursitis is the most common leg injury. It is a swelling that occurs over the kneecap. Head injuries such as concussions and neck injuries can occur but are rarely catastrophic. Another head injury is

auricularhematoma or "Cauliflower ear." This is swelling on the ear that occurs from trauma and bleeding under the skin.¹⁶

Due to the nature of this sport and its amount of physical engagement and intensity makes it extremely prone to injury. A study was conducted on 458 wrestlers and an amazing amount of 219 injuries were experienced in the 458 wrestlers over the course of the season, for an overall injury incidence of 5.2 injuries per 10 wrestlers (52%) in a season. One injury occurred roughly every 167 workouts or matches, and the most commonly injured parts of the body were the shoulders. Of all the injuries 24% were in the shoulders, and 17% in the knees. Surprisingly the wrestlers injured were on average about five months older than non-injured athletes and had a 32% higher experience level than non-injured wrestlers. The study concluded that experienced wrestlers were willing to take more chances during workouts and matches or attempted complex, more-likely-to-produce-injury maneuvers.² This sport is very rugged and is extremely prone to several types of injury.

Spring Sports

Two common spring sports in NEWMAC colleges and universities are baseball and softball.

Baseball and Softball

Baseball is a sport played between two teams usually of nine players each. It is a bat-and-ball game in which a pitcher throws (pitches) a hard, fist-sized, leather-covered ball toward a batter on the opposing team. The batter attempts to hit the baseball with a

tapered cylindrical bat, made of wood (as required in professional baseball) or a variety of other materials (as allowed in many nonprofessional games). A team scores runs only when batting, by advancing its players—primarily via hits—counterclockwise past a series of four markers called bases arranged at the corners of a ninety-foot square, or "diamond." The game, played without time restriction, is structured around nine segments called innings. In each inning, both teams are given the opportunity to bat and score runs; a team's half-inning ends when three outs are recorded against that team.

By the late nineteenth century, baseball was widely recognized as the “pastime” of the United States. The game is sometimes referred to as hardball to differentiate it from similar sports such as softball. Baseball on both the professional and amateur levels is popular in North America, Central America, and parts of South America, the Caribbean, and East Asia. For this study we will be focusing on both baseball and softball at a collegiate level. Softball is a very similar version of baseball and is played at the collegiate level strictly by females. A larger ball is used and pitched underhand. The diamond is also smaller to that of a baseball diamond. The two sports induce similar common injuries.

Common Injuries:

There are two main categories of baseball injuries, cumulative (overuse) and acute (traumatic). Generally, because of the non-violent nature of the sport, cumulative injuries tend to be more common. Injuries to the shoulder and elbow account for the majority of injuries to baseball players. Most of these injuries occur during the throwing motion. Acromioclavicular problems commonly begin with a cumulative injury such as shoulder separation. This is a common result of overuse, or prolonged stress to the glenoid

(shoulder socket). Regardless of the severity, most athletes with shoulder separation can return to their sport within a few weeks. Initial treatment should include anti-inflammatory medications and steroid injections. However if not taken care of immediately, as with most injuries, more damage to the shoulder can occur.

Impingement is the most common shoulder injury that is a direct result from throwing. It is a very common injury, especially in young athletes. Impingement is a result of constant irritation of anterior shoulder structures. These structures make up the roof of the anterior glenohumeral joint. The treatment for impingement during the early stages of the injury consists of rest, non-steroidal inflammatory drugs and rotator cuff strengthening exercises with the arm at one side.

The rotator cuff is another common site for a cumulative injury to a baseball player, the pitcher in particular. Due to the large amount of torque generated by the shoulder, an inflammation or tear in the rotator cuff can occur. While rest and anti-inflammatory medication can treat irritations, a tear in the rotator cuff may require surgery, resulting in a lengthy rehabilitation program before a player can return to the field. Stretching and strengthening the shoulder are activities that can help prevent almost all cumulative injuries and should be a part of a warm up and general conditioning program.

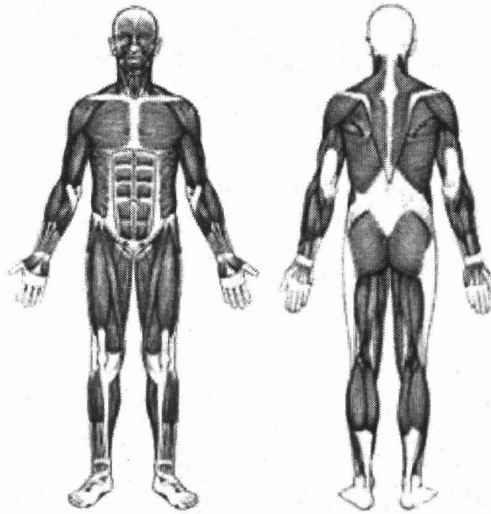
Baseball can sustain a great deal of injuries to the elbow. The repetitious, high velocity nature of the baseball throw induces chronic stresses at the elbow and predisposes the elbow to overuse syndrome. Commonly overuse injuries are encountered when the body's physiological ability to heal lags behind trauma. A significant tension force is absorbed by the medial elbow restraints during the late acceleration phases of the

throwing cycle. Chronic trauma to these structures can result in inflammation, scarring the medial collateral ligaments with possible rupture. Treatments of these injuries depend on the integrity of the medial ligament and the degree of joint instability. Treatment depends on the goals of the athlete; however, surgical reconstruction for ruptures of the medial collateral complex is usually necessary. Traumatic injuries to the elbow can also occur. If the muscles and tendons around the elbow are not strengthened properly, overthrowing can result in a large number of traumatic injuries, including severe bone fractures. This type of injury is typically seen at the professional or collegiate levels, where player's bodies are mature enough to create such a violent force on the joint. From a batter's standpoint, over-swinging and improper warm up techniques can result in injury. It is common in baseball for a batter to strain a shoulder muscle or, most commonly, the oblique muscle when swinging. Proper conditioning of the muscles and taking time to stretch before each at-bat can vastly decrease the chance of such an injury from occurring.

Baseball, although not considered a full contact sport, results in surprisingly high numbers of head and neck injuries. The mechanisms of head and neck injury in baseball include ball impact, collision trauma and sliding accidents. These are the result of chance and little can be done to prevent such injuries from strength and conditioning standpoint.

Frequently Injured Body Parts

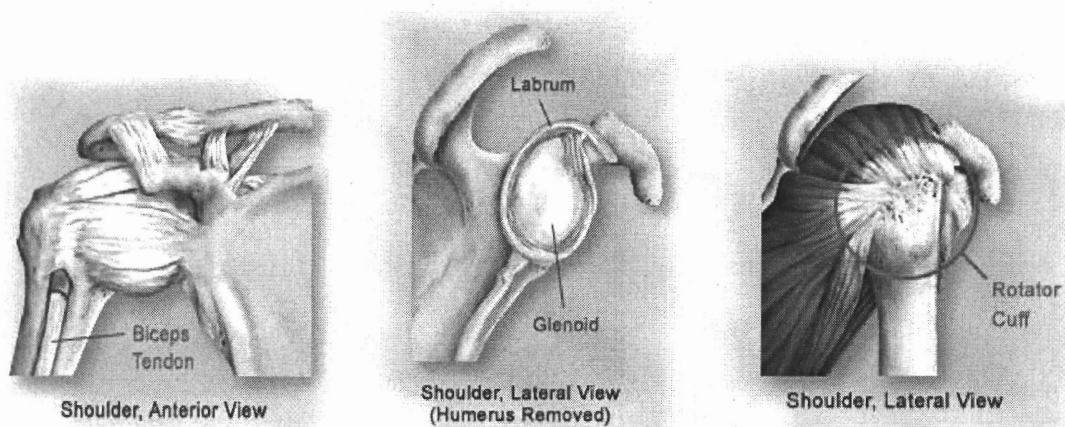
While playing participating in colligate level athletics particular parts of the body face many types of injuries due the intensity of the level of competition.



The Shoulder

The shoulder is the part of the body where the arm attaches to the torso. It is made up of three bones: the clavicle (better known as the collarbone), the scapula (shoulder blade), and the humerus (upper arm bone). These three bones along with associated muscles, ligaments and tendons come together to form the shoulder. The articulations between the bones of the shoulder make up the shoulder joints. The shoulder must be flexible for the wide range of motion required in the arms and hands and also strong to allow for actions such as lifting, pushing and pulling. It is even more critical that it be flexible and strong while competing in collegiate athletics. There are countless athletic uses for the shoulder depending on what sport is being played.

The two main bones of the shoulder are the humerus and the scapula. The joint cavity is cushioned by articular cartilage covering the head of the humerus and face of the glenoid (the end of the scapula). The scapula extends up and around the shoulder joint at the rear to form a roof called the acromion, and around the shoulder joint at the front to form the coracoid process. The glenoid meets the head of the humerus to form a cavity that acts as a flexible ball-and-socket joint. The joint is stabilized by a ring of fibrous cartilage surrounding the glenoid called the labrum.



Ligaments connect the bones of the shoulder, and tendons join the bones to surrounding muscles. The biceps tendon attaches the biceps muscle to the shoulder and helps to stabilize the joint. Four short muscles originate on the scapula and pass around the shoulder where their tendons fuse together to form the rotator cuff.

Common Shoulder Injuries

The shoulder is the least stable joint in all of the body, and therefore is often injured. Because of its instability, any large force put on the humerus or entire shoulder could result in a dislocation, subluxation, or separation. Prolonged abuse of the shoulder

commonly causes ligament damage as well, resulting in tendonitis, bursitis or a tear in the rotator cuff.

Shoulder Dislocation

The shoulder joint is the most frequently dislocated major joint of the body. In a typical case of a dislocated shoulder, a strong force that pulls the shoulder outward (abduction) or extreme rotation of the joint pops the ball of the humerus out of the shoulder socket. Dislocation commonly occurs when there is a backward pull on the arm that either catches the muscles unprepared to resist or overwhelms the muscles. When a shoulder dislocates frequently, the condition is referred to as shoulder instability. A partial dislocation where the upper arm bone is partially in and partially out of the socket is called a subluxation. Shoulder dislocations of all kinds are extremely common in the more physical sports such as football and ice hockey. Zero contact sports can also produce shoulder dislocations. For example, it is not uncommon for pitchers in baseball to have their shoulders sublux due to the great amount of torque being applied to the shoulder.

The shoulder can dislocate either forward, backward, or downward. Not only does the arm appear out of position when the shoulder dislocates, but the dislocation also produces pain. Muscle spasms may increase the intensity of pain. Swelling, numbness, weakness, and bruising are likely to develop. Problems seen with a dislocated shoulder are tearing of the ligaments or tendons reinforcing the joint capsule and, less commonly, nerve damage. Doctors usually diagnose a dislocation by a physical examination, and x rays may be taken to confirm the diagnosis and to rule out a related fracture.

Doctors treat a dislocation by putting the head of the humerus back into the joint socket of the scapula. This procedure is called manipulation and reduction. This is usually followed up with an x ray to make sure the reduction didn't fracture the surrounding bones. The arm is then immobilized in a sling or a device called a shoulder immobilizer for several days. Usually the doctor recommends resting the shoulder and applying ice three or four times a day. After pain and swelling have been controlled, the patient enters a rehabilitation program that includes exercises to restore the range of motion of the shoulder and strengthen the muscles to prevent future dislocations. These exercises may progress from simple motion to the use of weights. It should be noted that proper rehabilitation of such an injury can be expensive or be monitored on site by a certified strength and conditioning coach.

After treatment and recovery, a previously dislocated shoulder may remain more susceptible to being injured again, especially in young, active individuals (i.e. collegiate athletes). Ligaments may have been stretched or torn, and the shoulder may tend to dislocate again. A shoulder that dislocates severely or often, injuring surrounding tissues or nerves, usually requires surgical repair, another expense, to tighten stretched ligaments or reattach torn ones.

Shoulder Separation

A shoulder separation occurs where the collarbone meets the shoulder blade. When ligaments that hold this joint together are partially or completely torn, the outer end of the clavicle may slip out of place, preventing it from properly meeting the scapula. Most often the injury is caused by a blow to the shoulder or by falling on an outstretched hand. Most commonly, this injury occurs in collision sports (football and ice hockey),

but all the force that is needed for a separation to occur can be provided by the weight of one's body. This means that any sport in which one can fall to the ground (i.e. practically all of them) can produce a separation.

Shoulder pain or tenderness and, occasionally, a bump in the middle of the top of the shoulder (right over joint) are signs that a separation may have occurred. Sometimes the severity of a separation can be detected by taking X rays while the patient holds a light weight that pulls on the muscles, making a separation more pronounced.

A shoulder separation is usually treated conservatively by rest and wearing a sling. Soon after injury, an ice bag may be applied to relieve pain and swelling. After a period of rest, a therapist helps the patient perform exercises that put the shoulder through its range of motion. Most shoulder separations heal within 2 or 3 months without further intervention. However, if ligaments are severely torn, surgical repair may be required to hold the clavicle in place. A doctor may wait to see if conservative treatment works before deciding whether surgery is required.

Tendonitis and Bursitis

These conditions are closely related and may occur alone or together. Repeated motion involving the arms, or the aging process involving shoulder motion over many years, may also irritate and wear down the tendons, muscles, and surrounding structures. Tendonitis is inflammation (redness, soreness, and swelling) of a tendon. In tendonitis of the shoulder, the rotator cuff and/or biceps tendon become inflamed, usually as a result of being pinched by surrounding structures. The injury may vary from mild inflammation to involvement of most of the rotator cuff. When the rotator cuff tendon becomes inflamed and thickened, it may get trapped under the acromion.

Tendonitis is often accompanied by inflammation of the bursa sacs that protect the shoulder. An inflamed bursa is called bursitis. Sports involving overuse of the shoulder and occupations requiring frequent overhead reaching are other potential causes of irritation to the rotator cuff or bursa and may lead to inflammation and impingement. Signs of these conditions include the slow onset of discomfort and pain in the upper shoulder or upper third of the arm (even if one just has problems sleeping on the shoulder). Tendonitis and bursitis also cause pain when the arm is lifted away from the body or overhead. If tendonitis involves the biceps tendon (the tendon located in front of the shoulder that helps bend the elbow and turn the forearm), pain will occur in the front or side of the shoulder and may travel down to the elbow and forearm. Pain may also occur when the arm is forcefully pushed upward overhead.

The first step in treating these conditions is to reduce pain and inflammation with rest, ice, and anti-inflammatory medicines such as aspirin or ibuprofen. Gentle stretching and strengthening exercises are added gradually. If there is no improvement, the doctor may inject a corticosteroid medicine into the space under the acromion. While steroid injections are a common treatment, they must be used with caution because they may lead to tendon rupture. If there is still no improvement after 6 to 12 months, the doctor may perform surgery.

Rotator Cuff Tear

The rotator cuff tendons normally transmit the force of muscles originating on the scapula to the arm providing motion and stability. The most commonly affected tendon is that of the supraspinatus muscle. Defects in the rotator cuff can come from an injury (cuff tear) or from degeneration (cuff wear). Both commonly occur in sports in which

throwing is a large part of the game (i.e. baseball). The degree to which a tendon is reparable depends on its quantity and quality. Degenerated tendons are often frail and retracted and may not be amenable to repair. People having had cortisone injections often have weaker tendon tissue that fails without a significant injury. By contrast those whose tendon was torn by a substantial fall often have good quality tendon that can be repaired if surgery is performed promptly after the injury. The symptoms of rotator cuff disease include difficulty lifting the arm. Repair of a rotator cuff requires that the tendon be securely anchored to the bone at surgery and that the repair be protected for several months during healing.

The Hamstring

The hamstring refers to one of the many tendons that make up the space behind the knee. The medial hamstring comprises the tendons of the semimembranosus and semitendinosus, gracilis, and sartorius muscles; the lateral hamstring is the tendon of the biceps femoris muscle. The medial hamstring contributes to medial rotation of the leg at the flexed knee joint, whereas the lateral hamstring contributes to lateral (outwards) rotation. These four medial hamstring muscles of the posterior thigh, one bends the knee, while three of the four extend (straighten) the hip. The short head of the biceps femoris, with its divergent origin, is not involved in the hip extension, and thus is sometimes excluded from the '*hamstring*' characterization. The hamstrings play a crucial role in many sports related activities, such as, walking, running, jumping, and controlled accelerating movements in the trunk of the human body.

The hamstring in the human leg crosses and acts upon two joints - the hip and the knee. The tendons, Semitendinosus and semimembranosus, extend the hip when the trunk

is in a fixed position. Or these tendons extend the trunk when the hip is in a fixed position. They also flex the knee and rotate the lower leg when the knee is bent. The long head of the biceps femoris extends the hip when we begin to walk. Both the short and long heads of the femoris flex the knee and laterally (outwardly) rotates the lower leg when the knee is bent. In collegiate sports these tendons that make up the hamstring and control the motion of the hip and knee can be easily injured in many ways.

Many injuries occur on the field of play, but also are caused by not preparing the body properly before any form of physical activities. The first and most common injury is called a strain. A strain in the hamstring is also known as a *pulled hamstring*. Straining of the hamstrings is defined as an excessive stretch of muscle fibers and related tissues. A third degree strain is the final stage and most intense, of hamstring strains. It includes a complete tear of the hamstrings muscles. The tear can be felt with an individual's hand. There is discoloration and intense pain. Third degree strains are a rare occurrence. Hamstring strains can occur in many different ways, but most of ten when the muscles are weakened. A *pulled hamstring* most likely occurs during some athletic activity or some sort of exercise. If there is strain on the hamstring and the individual continues athletic activity or exercise on it, the hamstring continues to strain more and more.

Another injury to the hamstring is the *high hamstring tendinopathy*. This condition consists of pain in the thigh or buttock. This injury is commonly seen in middle and long distance runners. The pain experienced with high hamstring tendinopathy is experienced when accelerating. Although there are many ways a hamstring can be injured, it can be summed up by two words, strain or tear. Common signs of hamstring injuries are:

- **Bruising:** Small tears within the muscle cause bleeding and subsequent bruising. The bruise begins in the back of the thigh, and as time passes the bruise will pass down below the knee and often into the foot.
- **Swelling:** The accumulation of blood from the hamstring injury causes swelling of the thigh. This can make further muscle contraction difficult and painful.
- **Spasm:** Muscle spasm is a common and painful symptom of a hamstring injury. Because of the trauma to the muscle, signals of contraction are confused, and the muscle may be stimulated.
- **Difficulty Contracting:** Flexing the knee is often painful after a pulled hamstring, and can even prevent a person from walking normally. If you are unable to contract the hamstring, the muscle may be completely ruptured.¹⁵

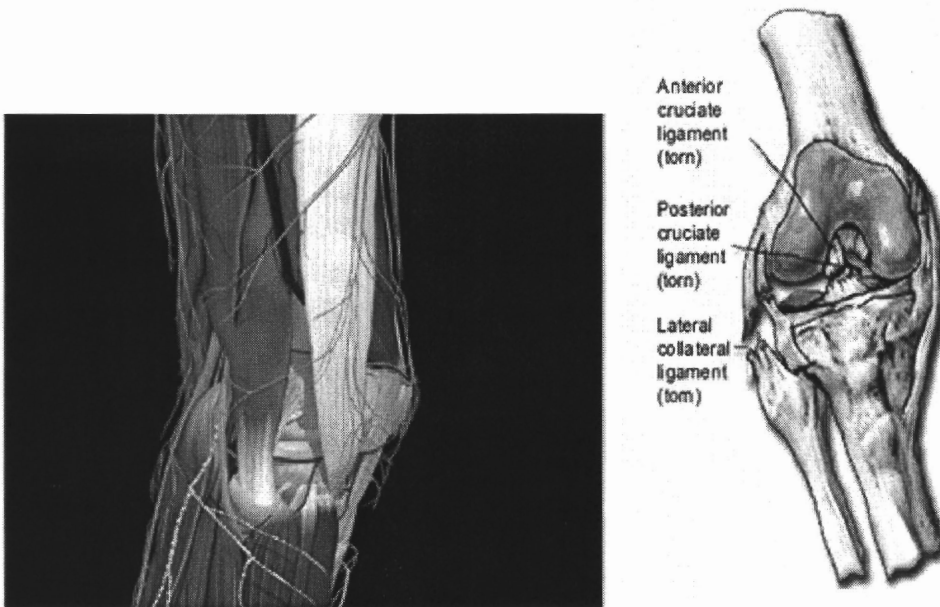
The Knee

In human anatomy, the knee is the lower joint connecting the femur, commonly known as the thigh bone, and the tibia, the main bone of the lower leg. In humans it supports nearly the entire weight of the body. The knee is a complex and compound system of two separate joints.

These two separate joints are conjoined by a condyloid variety of a synovial joint that hovers. The first joint the knee is made up of is the *femoro-patellar joint*. This consists of the patella, commonly known as the kneecap", and the patellar groove on the front of the femur through which it slides. The second joint is the *femoro-tibial joint*. This links the femur with the tibia. This particular joint is bathed in a viscous synovial fluid which is contained inside the "synovial" membrane, the joint capsule. This is used to sever as a buffer and shock absorbers for both joints during movement.

For further shock absorption the knee is also made up of menisci. Menisci are cartilaginous elements inside the knee joint that serve to protect the ends of the bones from rubbing on each other. There are two menisci in each knee, the medial meniscus and the lateral meniscus.

The human knee is connected with the several ligaments. Ligaments are fibrous tissue that connects bones or two different parts of a single bone. The following are the four main ligaments that are associated with the knee:



Anterior Cruciate Ligament

This ligament is commonly known as the ACL. The main importance of the ACL is to prevent the tibia from being pushed too far anterior relative to the femur. It runs from the *lateral condyle* of femur to the *anterior intercondylar* area.

Posterior Cruciate Ligament

This ligament is commonly known as the PCL. It runs from the *medial condyle* of femur to the *posterior intercondylar* area. This arrangement allows the PCL to oppose forces pushing the tibia extremely posterior relative to the femur.

Medial Collateral Ligament

This ligament is commonly known as the MCL. The MCL protects the medial side of the knee from being bent by a valgus force, an outward bending force. It runs from the *medial epicondyle* of the femur to the *medial tibial condyle*.

Lateral Collateral Ligament

This ligament is commonly known as the LCL. The LCL protects the lateral side from a varus force, an inside bending force. It runs from the *lateral epicondyle* of the femur to the head of fibula. Some other ligaments are the *capsular* ligament, the *ligamentum patellae*, the *oblique popliteal* ligament and the *arcuate popliteal* ligament. The knee primarily permits flexion, a movement that decreases the angle of a joint, and extension, a movement that increases the angle of a joint. It also allows for a slight medial and lateral rotation. Flexion is permitted up to 120° when the hip is extended, 140° when the hip is flexed and 160° when the knee is flexed passively. Medial rotation is limited to 10° and lateral rotation to 30°. ¹⁵

Common Injuries on the Knee

There are two general kinds of knee injuries that occur, mechanical and inflammatory. Mechanical knee problems result from injury, such as a direct blow or sudden movements that strain the knee beyond its normal range of movement. These injuries occur especially in sports. Other problems, such as osteoarthritis in the knee, result from wear and tear on its parts. The inflammation that occurs in certain rheumatic diseases, such as rheumatoid arthritis and systemic lupus erythematosus, can also damage the knee.

The knee joint allows you to run, walk and play sport. Awkward movements, falls and collisions, sudden twists, excessive force or overuse can result in a range of injuries to the knee joint and the structures supporting it. Common knee injuries include ligament, tendon and cartilage tears, and patello-femoral pain syndrome. Below are the descriptions of these injuries:

Ligament Sprains

The knee joint is held together by tough bands of connective tissue called ligaments. Sudden twists or excessive force on the knee joint, commonly caused by repeated jumping or coming to a rapid halt while running, can stretch ligaments beyond their capacity. Torn ligaments can bleed into the knee and typically cause swelling, pain and joint laxity. The anterior cruciate ligament (ACL) situated in the centre of the joint is the knee ligament commonly injured. A ruptured ACL does not heal by itself and may require reconstructive surgery.

Tendon Tears

The muscles are anchored to the joints with tendons. Overstretched tendons can tear and bleed, but these injuries tend to heal by themselves without the need for surgery.

Cartilage Tears

The knee joint is bolstered on both sides by additional strips of cartilage, called 'menisci' or semilunar cartilages. One of the most common knee injuries is a torn or split meniscus. Severe impact or twisting, especially during weight bearing exercise, can tear this cartilage. Tears of the meniscus can also occur in older people due to wear and tear. Symptoms include swelling, pain and the inability to straighten the leg. The damaged

cartilage can be surgically trimmed or even removed without causing any joint instability.

Patello-Femoral Pain Syndrome

Patello-femoral pain syndrome is characterized by pain felt behind the kneecap. Squatting, walking up and down hills or stairs, or sitting still for extended periods of time can exacerbate the pain. The usual cause is abnormal movement of the kneecap as the knee is bent and straightened. This can lead to wear and tear of the cartilage on the back of the kneecap. Imbalances in muscle strength, tight muscles and structural abnormalities of the lower limb can contribute to the problem. The pain usually comes on gradually over time.

Recovery Time for the Knee

Before the advent of arthroscopic surgery, a minimally invasive surgical procedure in which a physical examination of the interior of a joint is performed using an arthroscope, patients having surgery for a torn ACL required at least nine months of rehabilitation. With current techniques, such patients may be walking without crutches in two weeks, and playing some sports in but a few months.

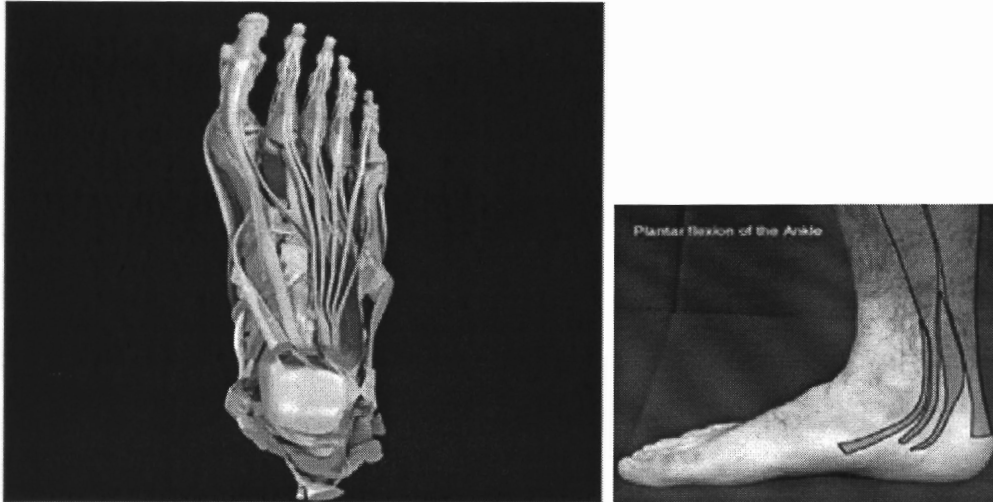
The advantage of this type of surgery over traditional open knee surgery is that the joint does not have to be fully exposed. In its place, only two small incisions are made, one for the arthroscope and one for the surgical instruments. As a result the recovery time of the patient is reduced. Arthroscopy may increase the rate of surgical success due to fewer traumas to the connective tissue. It is particularly useful for professional athletes who frequently injure knee joints and require fast healing time. There is also less scarring, since the incisions made are smaller.

In Australian rule football, knee injuries are among the most common, with a great deal of controversy caused in ruck contests, where the crashing of two knees during the leap has caused injuries to numerous players. This forced new rule changes in the AFL for the 2005 season.

In addition to developing new surgical procedures, ongoing research is looking into underlying problems which may increase the likelihood of an athlete suffering a severe knee injury. These findings may lead to effective preventive measures.

The Ankle and Foot

The human foot is used primarily for movement and the ankle joint is formed where the foot and the leg meet. The ankle is a synovial hinge joint that joins the ends of the tibia and fibula, in the lower limb of the leg, with the talus bone in the foot. The ankle joint is responsible for dorsiflexion and plantar flexion. Dorsiflexion is the movement of the toes up and during this the anterior ligaments of the joint become shorter while the posterior ligaments become longer. An example of this is when one stands only on their heels. Plantar flexion is movement of the toes down and during this the anterior ligaments of the joint become longer while the posterior ligaments become shorter. An example of this is when one stands only on the toes. Although the ankle allows a large range of motion, it does not allow rotation.¹⁵



Common Foot and Ankle Injuries

Athletes, especially those who jump while playing their sport risk ankle sprains all the time because they can accidentally land on the side of their foot. Such sports, like contact or kicking sports, expose the foot and ankle to potential trauma-direct blows, crushing, and displacement.

Ankle Sprains

Sprained ankles are one of the most common injuries in sports. Because the inner ankle is more stable than the outer ankle, the foot is likely to turn inward from a fall, tackle, or jump. This stretches or tears ligaments; the result is an ankle sprain. The lateral ligament on the outer ankle is most prone to injury.

Achilles Tendon Injury

The strongest and largest tendon, the Achilles tendon connects muscles in the lower leg with the heel bone. Sports that tighten the calf muscles, such as basketball, running and high-jumping can overstress this tendon and cause a strain (Achilles tendinitis) or a rupture. A direct blow to the foot, ankle, or calf can also cause it.

Overuse Injuries

Excessive training, such as running long distances without rest, places repeated stress on the foot and ankle. The result can be stress fractures and muscle/tendon strains.

Shin Splints

Pain in front of the shin bone (tibia) usually is caused by a stress fracture, called shin splints. It is possible for people to injure their feet and ankles but there are certain activities that make people most susceptible to foot and ankle injuries. Activities such as extensive running, exercise, or training can overstress the ligaments and lead to injury. This, especially prevalent in football, hockey, and soccer-trauma, can dislocate a joint, fracture a bone, stretch or tear ligaments, or strain muscles and tendons.

Improperly fitting of footwear for a particular sport can damage your feet as well as the playing of it. With the wrong shoes during training exercises such as running up hills, or on bumpy roads, one is predispose to serious sprains and strains. This is true for also starting a new sport without proper conditioning.

Importance of Having an

Organized Team Injury Database

Organized team injury databases are a critical piece of injury prevention efforts, because it gives athletic injury professionals accurate data that identify where, when, and how student athletes are getting hurt. By using this information, strength and conditioning coaches can pinpoint risk factors within their individual schools and athletics.

Athletic organizations can develop safety guidelines and preventive programs for their universities. School-related injuries are a significant public health problem. Appropriate interventions and preventive programs can minimize the physical and financial impact of injury on the individual, family, school, and community. Injury databases can help organize these school-related injuries so that these prone injuries can be assessed by professionals and actions can be made.

As we conducted our research within local NEWMAC schools we noticed an overall struggle with an organization workload needed to sort through athletic injuries. We believe if all NEWMAC schools had a generalized injury database system then sorting of student injury reports would be much easier. It would grant strength and conditioning coaches with useable information that could be looked at, searched, and sorted through with ease. Then conclusions can be made about various athletic training programs on campus.

In conclusion, we have included a sample injury report form that could be used to satisfy the need for injury databases throughout NEWMAC schools. After filling out these forms, work study employment can be granted to students whom are looking for

jobs, so that data can be placed into the computers. If confidentiality is a problem then each athlete can be assigned an ID Sports Number. This would create a computerized database that could easily be searched through, sorted, and researched. In belief, every college athletics department should have an injury database to help prevent serious injuries to their student athletes.

Strength and Conditioning Coaches

While nearly every collegiate team has a detailed workout program, most do not have one organized by a qualified professional. To be considered a certified strength and conditioning coach, one must fulfill three requirements as determined by the National Strength and Conditioning Association (NSCA).¹²

Qualification Requirement 1

The Strength & Conditioning practitioner should acquire a bachelor's or master's degree from a regionally accredited college or university (verification by transcript or degree copy) in one or more of the topics comprising the "Scientific Foundations" domain identified in the Certified Strength & Conditioning Specialist (CSCS) Examination or in a relevant subject. An ongoing effort should also be made to acquire knowledge and skill in the other content areas.

Qualification Requirement 2

The Strength & Conditioning practitioner should achieve and maintain professional certification(s) with continuing education requirements and a code of ethics,

such as the CSCS credential offered through the NSCA CERTIFICATION COMMISSION. Depending on the practitioner's scope of activities, responsibilities, and knowledge requirements, relevant certifications offered by other governing bodies may also be appropriate.

Qualification Requirement 3

The productivity of a Strength & Conditioning staff, as well as learning and skill development of individual members, should be enhanced by aligning a performance team comprised of qualified practitioners with interdependent expertise and shared leadership roles. Once the team is assembled, respective activities and responsibilities, as well as appropriate liaison assignments, should be delegated according to each member's particular "Scientific Foundations" expertise.

The Importance of Proper Strength and Conditioning

The importance of strength and conditioning coach for athletes at the collegiate level is growing everyday. As the level of play continues to become more competitive, it is important that today's athletes be provided with proper guidance and supervision in the weight room and on the playing field. The benefits of hiring a certified strength and conditioning coach may be greater than one would think. The fields of sports medicine and exercise sciences are growing with each day and it is important to keep up with the latest practices. While having immediate access to the vast knowledge of sport/exercise sciences would certainly help keep athletes competitive, it would help promote safety as well. Proper preseason and in-season workouts can help prevent common injuries from

occurring. Also, the presence of a strength and conditioning coach will drastically decrease the amount of injuries caused by bad technique in the weight room. Proper supervision is essential, especially on a college campus where people's schedules vary so greatly and coaches cannot spend the entire day in the gym.

The athletes themselves would not be the only ones benefiting from the presence of a certified strength and conditioning coach, the university itself would as well. In general, with a strength and conditioning coach, teams will perform better, which gives them a better chance of winning titles, which gives the school more press, which creates more interest in the school from a prospective student's point of view, which turns into an increase in tuition collected, etc., etc. It has been estimated that 80% of all court cases regarding athletic injuries deal with some aspect of supervision. Although these types of serious accidents are not all too common, the liability costs associated with inadequate supervision are very expensive.

Financial Feasibility

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of Essentials Of Strength Training & Conditioning) summarize the following key liability concepts for the Strength & Conditioning professional:

Assumption of risk: voluntarily participation in activity with knowledge of the inherent risk(s). Athletic activities, including Strength & Conditioning, involve certain risks. Participants must be thoroughly informed of the risks of activity, and required to sign a statement to that effect.

Liability: a legal responsibility, duty or obligation. Strength & Conditioning professionals have a duty to the athletes they serve to take reasonable steps to prevent injury, and to act prudently when an injury occurs.

Negligence: failure to act as a reasonable and prudent person would under similar circumstances. Four elements must exist for a Strength & Conditioning professional to be found liable for negligence: duty, breach of duty, proximate cause, and damages. Simply stated, a Strength & Conditioning professional is negligent if he/she is proven to have a duty to act, and to have failed to act with the appropriate standard of care, proximately causing injury or damages to another person.

Standard of care: what a prudent and reasonable person would do under similar circumstances. A Strength & Conditioning professional is expected to act according to his/her education, training and certification status (e.g., CSCS, NSCA-CPT, CPR, First Aid).¹²

Sports Injury Clinics

Another alternative to having a strength and conditioning coach to care for the needs of student athletes is found at sports injury clinics.

General Significance

A sports injury clinic is a facility that is used to care for individuals with injuries that fall under the definition of a sports injury. A sports injury is one that happens when playing sports or exercising. Some are from accidents but others can result from poor training practices or improper gear. People at times get injured when they are not in proper condition and not warming up or stretching enough before you play or exercise can also lead to injuries.¹¹ The aim of a sports injury clinic is to help each individual overcome their moments of vulnerability, in trauma or in training, with absolute confidence, and get them back to performing at their very best.¹⁴

One example of a sports injury clinic is physical therapy clinic. In these clinics the primary care associate for injured individual is known as physical therapists. According to the American Physical Therapy Association, physical therapists are health care professionals who diagnose and treat people of all ages who have medical problems or other health-related conditions that limit their abilities to move and perform functional activities in their daily lives. They are individuals that help prevent conditions associated with loss of mobility through fitness and wellness programs that achieve healthy and active lifestyles. Physical Therapists examine individuals and develop plans using treatment techniques that promote the ability to move, reduce pain, restore function, and prevent disability.¹⁵

There are many types of sports injury clinics offering various types of treatment to care for various injuries with various methods. As a result most clinics are forced to cover a wide range of skills such as osteopathy, physiotherapy, acupuncture and hypnotherapy, each treating injuries in ways specific to the patient. With these clinics the each individual can recover from an injury in a fraction of the time it would take if they did not go to the clinic, however the price of such clinics are not for the weak of heart.

Financial Feasibility

Sports injury clinics have a range of prices for the services they provide. In the case of physical therapy clinics, patients are required to pay a certain amount with each visit. In the case of physical therapy for a post-operation of an ACL reconstruction surgery, the patient needed to pay \$70 dollars per visit and was required to 16-24 visits. With the required amount of visits the patient would be required to pay a total of \$1120 to \$1680 without insurance. With insurance the patient would pay a co-pay of \$15 for each visit, a total \$240 to \$360. Other types of clinics performed by chiropractors and masseuses, full body massage for \$65⁸, have flat rate prices and prices particular to each patients needs.

Strength and Conditioning Coaches vs. Physical Therapy Clinics

Both physical therapy clinics and onsite strength and conditioning coaches provide beneficial services to collegiate universities and their athletes. Each is an acceptable aid for rehabilitation. While this is true, the costs of physical therapy visits and salaries of certified strength and conditioning coaches are significant. However, strength and conditioning coaches provide a service that helps prevent injuries and rehabilitate injuries, whereas the function of physiotherapy clinics is solely to rehabilitate injuries that have already been sustained.

Having an onsite strength and conditioning coach provides students with a large array of services. For one, education would be available for all athletes regarding ways to take care of themselves and strength train properly, and as a result, the rate of injuries should decrease. If an injury were to occur, the onsite strength and conditioning coach would be available for immediate care. Also, due to interaction with the athletes on a regular basis, the onsite coach would have background knowledge pertaining to the athlete and his or her previous injuries. With a physical therapy clinic, immediate care would not be administered to the athlete nor there a preexisting hands-on relationship with the athlete's previous injuries.

Not only do strength and conditioning coaches help prevent and rehabilitate injuries, but they would also increase the level of competitiveness in the school's athletes. A certified strength and conditioning coach would be well schooled in the latest practices

of athletic strength training and could properly instruct all athletes on how to improve their performance according to the sport they play.

Ideally a strength and conditioning coach would need to be onsite and available during workouts, practices, and games, but due to the colligate lifestyle and amount of sports, doing such would require working extremely long and odd hours of the day. Due to the high number of injured students, according to previous data, it would be nearly impossible for one single coach to tend to all. Consequentially, due to the high demand of service such a position would require a team of trainers to work closely with the strength and conditioning coach.

While it is better to have a strength and conditioning coach it would ultimately cost the institution more money. If the student were to seek help from a physical therapy clinic, they would be required to pay for their own cost and not the institution. Physical therapy clinics offer a better therapist to patient ratio for most rehabilitation workouts and provide a wide variety of treatments for injuries. However it's off campus location may provide transportation problem for injured college students. Also the unfamiliarity of the patient to the therapist might prevent the full rehabilitation of the injury. Studies have shown that an injury rehabilitated by a physiotherapy clinic is more likely to fail than that of a familiar strength and conditioning coach.

Discussion

Throughout our studies we also came to the realization that strength and conditioning coaches would reduce injuries in collegiate athletics and improve overall performance of student athletes. Based on our research, we predicted that having a sufficient record keeping database for collegiate injuries was vital to reducing and treating athletic injuries. However, due to circumstances beyond our control we were unable to gather a sufficient amount of data to support our hypothesis. We found that schools were unable or unwilling to share their athletic injury data due to a lack of sufficient, easily accessible databases. It would be beneficial for all college conferences to adopt one style of a record keeping database to enable inner conference communication with the hope of curing injuries at a faster rate.

As we continued our research, despite the circumstances, we found that having a large amount of varsity sports on a college campus brought a large number of critical injuries each year. As collegiate athletics become more competitive the severity of these injuries increases significantly. It is extremely beneficial to have a properly trained individual, such as a strength and conditioning coach or a physical therapist to treat their injuries.

With our research we have concluded, both physical therapist and strength and conditioning coaches provide care for injured athletes. However we have determined that strength and conditioning coaches would be more beneficial to student athletes than physical therapists. Strength and conditioning coaches are always on campus, making them easily accessible. These coaches are able to respond to injured students immediately after their injuries, while in the case of a physical therapist being located off campus,

their response time is significantly reduced. Also, students having to be transported to the off campus location is an added problem.

The cost of strength and conditioning coaches would be taken care of by the college university vs. the student taking care of the cost of physical therapist themselves. It would be expensive for the university, but ultimately the injured students would benefit more with the onsite location of the strength and conditioning coach. The coach would also be able to care for all injured students, both varsity athletes and non-athletes, making the cost evenly distributed amongst all students, which can be incorporated into the tuition bill.

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