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A Comparison of Men's and Women's Division I Ice Hockey Injuries

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A COMPARISON OF MEN'S AND WOMEN'S DIVISION I ICE HOCKEY INJURIES

by

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The purpose of this study was to gather and analyze data regarding Men's and Women's Division I ice hockey injuries, what caused these injuries, how often they occurred, what position player was more prone to injury ,and how much time ,if any, was lost from participation due to injury. Data were collected with the intention to help athletic departments plan for a sufficient medical staff, inform coaches and players of the injuries most common to the sport of ice hockey, and plan an injury prevention program for athletes.

Participants of this study (N=85) were members of both St. Cloud State University's Division I men's (n=22) and women's ice hockey teams as well as members of the University of New Hampshire and University of Minnesota's Division I women's ice hockey teams (n=63).

A total of 135 injuries were reported. The women experienced 1.25 injuries per player, nearly half of the men's 2.6 injuries per player. Seventy-four injuries were a result of collisions with the men reporting 31 (1.47 inj/player) injuries compared to the women reporting 43 (.67 inj/player) injuries. There was not a significant difference between genders when comparing soft tissue and head/neck injuries. The women however did suffer more bone and joint injuries when compared to the men. Male forwards (offense) suffered far more injuries than their female counterparts. No difference was noted among defenders of either gender.

Based on these data, it can be concluded that female Division I ice hockey players are predisposed to the same injuries that their male counterparts suffer. Sports medicine staffs should plan to provide medical coverage for women's and men's Division I ice hockey teams equally because the women have similar injury numbers, injury types and injury occurrences when compared to men.

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Chapter 1

THE PROBLEM

Introduction

Ice hockey is a game involving speed, sudden stops and starts, and hard bursts of energy that demand high skill, coordination and courage (Sim, 1989).

Not only are males playing the sport, but recently ice hockey has become increasingly popular among female athletes. Success can be attributed to the United States Women's Olympic Ice Hockey Team winning the gold medal at the 1998 Nagano Games. With this increased interest in the sport, the sports medicine community is now becoming involved in determining injury rates as well as the causes of these injuries (Noyes, 1988). With the increase number of women participating in ice hockey, can a difference be noted in the number of injuries at the women's and men's level? Is there a difference in the incidence and type of injuries associated with women's and men's ice hockey?

Purpose

The purpose of this study was to analyze injury data collected from Women's and Men's Division I Ice Hockey Programs. These data were used to evaluate three areas of interest.

1. To establish an overall injury rate and injury type among male and female Division I ice hockey players.
2. To compare and contrast types and incidence of injuries between male and female Division I ice hockey players.
3. Compare types of injuries and incidence of injuries by player position in women's and men's Division I ice hockey players.

Background of Problem

Increased sport popularity has heightened awareness regarding the number as well as the severity of injuries in the sport of ice hockey. This concern has resulted in a closer examination of injury rates, types, and injury mechanism. This has lead to rule and equipment changes, in the hope for a reduction of injuries. Current literature on incidence rates in ice hockey indicates that there is a significant injury risk when compared to other sports. These injuries range from the most severe head injury and fractures, to contusions and lacerations (Walkden, 1988). Lorentzon (1988) reported that 80-85% of ice hockey injuries were caused by trauma, while the remainder was due to overuse. Stuart et. al. (1995) found that a player was 25 times more likely to be injured in a game than in practice, and most likely to sustain that injury during the third period.

Walkden (1998) reported that most injuries in men's ice hockey occur as a result of contact with other players, sticks, pucks, and collisions with the

boards. Stuart (1995) reported that 51% of male ice hockey injuries were the result of collision (either between players, players and the boards or the goal posts, or players with a stick or a puck). This high percentage was believed to occur due to the high speed of the game and the fact that the rules allow body contact.

Although women's hockey is a fast game, it does not approach the speed in skating, puck velocity and contact between players that the men experience. In addition, rules limit the intentional contact between players. Some believe that this will result in fewer contact injuries for the women as compared to the men. Walkden (1998) examined injury data and speculated that many injuries in women's ice hockey were the result of poor skating techniques and defensive maneuvers which may be a result of the relative newness of the sport itself. Dr. John Powell suggests that the risk of injury in women's hockey would be reduced by 15-20% due to these differences (John Powell, personal letter to author, March 13, 1998).

A women's ice hockey team, like a men's team, will sustain a number of injuries during their season of play. These injuries can occur during practices or games. Some injuries will be relatively minor and some more serious (personal interview with John Powell). Dr. John Powell noted that the assessment of the basic risk of injuries requires consideration of the following concepts regarding injuries:

1. Many of the injuries in ice hockey are acute and occur in a fraction of a second when a number of variables, such as position, player activity and team activity, come together to create the force that causes the injury.
2. There is a level of risk associated with each sport that is based on the nature of the game, the conditions under which the game is played and the skills and abilities of the players.
3. Games that are played under the same rules in the same arenas, using the same number of players that play for the same amount of time will have similar risk patterns. The differences that exist (e.g., collision vs contact) will help sports medicine professionals identify the variables between two "similar" sports.

Game rules vary little between gender-specific ice hockey teams with the exception of tackling (body checking). Even though hockey is characteristically aggressive, neither girls nor women's hockey permits checking at any level of the game. Also, women are required to abide by the same equipment requirements as male participants (Walkden, 1998).

Statement of Problem

Data from this study provided baseline information regarding Men's and Women's Division I Ice hockey injuries, the number of injuries, types of injuries,

causes of these injuries, as well as a comparison of these injuries by player position.

Significance of Problem

Sports medicine professionals are a vital part of collegiate athletics. The results of this study can be used to help plan an appropriate sports medicine staff, based on the expected number of risks involved with each level of hockey (men's and women's). This study may also help inform coaches and athletes of the risks associated at each level of their sport and it will allow schools to construct an injury prevention plan through proper coaching, training and playing techniques.

Definition of Terms

Acute–Having rapid onset, severe symptoms and a short course; not chronic (Taber's, 1997).

Adduction–Limb or eye movement toward the main axis of the body or axial line of limb (Taber's, 1997).

Collateral Ligaments–One of the ligaments that provide medial and lateral stability to joints (Taber's, 1997).

Dural Mater–A fibrous connective tissue membrane, the outermost of the meniges covering the spinal cord and brain (Taber's, 1997).

Epidural Hematoma–Swelling, blood mass or clot located above the dura mater, usually arterial, except in the posterior fossa (Taber's, 1997).

Hyperextension–Extreme or abnormal extension (Taber's, 1997).

Iliac Crest–In relation to the ilium, the hip, the upper free margin of the ilium (Taber's, 1997).

Lumbosacral–Pertains to lumbar vertebrae and the sacrum (Taber's, 1997).

Maxifacial–Pertains to the maxilla (jawbone) and face (Taber's, 1997).

Metacarpalphalangeal–Concerning the metacarpals (five metacarpal bones of the hand) and phalanges (any bone of the fingers and toes) (Taber's, 1997).

NCAA–National Collegiate Athletic Association.

Ulnar Collateral Ligament–The medial elbow ligament that provides medial joint stability (Taber's, 1997).

Valgus–Position of a body part that is bent outward (Arnheim, 1993).

Varus–Position of a body part that is bent inward (Arnheim, 1993).

Velocities–The quickness of time. $\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$

Viscera–Internal organs enclosed within a cavity, especially the abdominal organs (Taber's, 1997).

Limitations

1. A small response rate may limit this study, as it may not accurately account for the injuries rates of other Division I Ice Hockey teams within the United States. At the time of this study, there were

significantly less Division I women's ice hockey programs in the United States when compared to men's programs'. Besides using St. Cloud State University women in this study, two other schools with established women's hockey programs and experienced athletes were included.

2. Any generalizations were limited to the injury types and rates of both Men's and Women's Division I ice hockey teams at St. Cloud State University, Women's Ice Hockey players at The University of Minnesota and Women's Ice Hockey players at The University of New Hampshire as the survey was only directed towards these schools.

Chapter II

REVIEW OF LITERATURE

Injury Potential

The game of ice hockey is a fast-paced, physical game in which violence is common and injuries are frequent. Sim et al. (1987) suggested that ice hockey might be one of the most violent team sports in the world. Because of its speed and fury injuries are likely to occur. Fortunately, the number of serious injuries is not as great as one might expect (Sim, 1989). At the collegiate and professional level, where the speed and forces are great, injury rates were recorded as 2.48 and 3.0 injuries per player per year, respectively (Sim, 1989).

The potential for injury in this sport is related to skating speeds of up to 30 mph, pucks traveling at speeds greater than 100 mph, sharp skate blades, long sticks, and frequent collisions (Stuart, 1995). Such collisions can result in blunt injuries to the extremities, viscera, and head. Added to this is the violence that is possible with these skates, pucks and stick blades (Daly, 1990).

The majority of the damaging forces to the soft tissue, bone, and articular joint structures of modern hockey players during energetic activities involved in the game are attributable to impact during high speed motion. In addition, non-

contact soft tissue injuries are common because of the complex forces that are involved (Sim, 1978).

High magnitude muscle forces predispose the ice hockey player to non-contact soft tissue injuries (Sim, 1989). Particularly, high acceleration and deceleration forces combined with dynamic stability requirements on the ice surface expose the ice hockey player to these soft tissue, non-contact injuries, especially groin (hip flexor and extensors) strains (Sim, 1987). Lorentzon et al. (1988), in a study of Swedish Elite Hockey Players, documented that the groin was the most common site of muscle strains. These injuries reportedly were due to non-impact forces. For example, the powerful push-off in skating results in hip muscle forces ranging up to 2.5 times the person's body weight (Sim, 1989). With such forces, it is easy to understand why hip and groin injuries are common non-impact type injuries in ice hockey (Sim et al., 1989).

As noted previously by Stuart (1995) collisions accounted for 51% of male ice hockey injuries. These collisions were with other players as well as the boards. Injuries caused by collisions with the ice and goal posts were not a major contributor to collision injuries in the same study. Another study of ice hockey injuries looked at velocities with respect to collisions with other skaters as well as the boards (Daly, 1990). Sim and Chao (1978) documented skating velocities of 30 mph for collegiate level hockey players (male) and 20 mph for pee-wee (12 yr. old) level ice hockey players (male). Sliding speeds of about 15 mph were also recorded in male collegiate ice hockey players (Sim, 1978).

Because the player had less ability to change direction or position while sliding, injuries to unprotected body parts were more likely during this time (Daly, 1990). In a study of neck injuries in ice hockey, sliding which resulted in a collision, with the boards, goal posts, or another skater was a common mechanism of cervical spine injuries (Tator, 1987).

The next potential injury-causing piece of equipment in hockey is the puck itself. The puck is made of processed rubber weighing 6 ounces, measuring 3 inches in diameter and 1 inch in thickness, and is capable of traveling at tremendously high speeds (Sim, 1987). According to Sim et al., the hockey puck is involved in 15% to 20% of hockey injuries (Sim, 1989).

Traveling at speeds of up to 100 mph (Sim, 1989), it is not hard to believe that the puck can do great damage. Contusions as well as lacerations were the most common injury reported due to contact with the puck. Bishop (1976) and Norman et al. (1990) studied puck impact on different types of ice hockey masks and noted that deformation of the face mask occurred at puck speeds as low as 50 mph and that deformation with facial contact occurred at puck speeds nearing 60 mph (Sim, 1987). Peter Daly (1990) recorded puck speeds near 90 mph in collegiate men's hockey and 120 mph in professional hockey. Considering these factors, The Canadian Standards Association increased face masks standards to require that they be made of heavier material and mounted further form the face (Daly, 1990), in hopes to reduce face to mask contact. However, there is concern that the heavier face masks,

mounted further away from the face, have the potential for raising the center of gravity above the head and may increase the number of significant head injuries (Sim, 1987).

The hockey stick can inflict wounds on unprotected areas, producing lacerations, contusions, and fractures, as well as loss of teeth, when there is no facial protection (Sim, 1989). Sane et al. (1988) also documented that maxifacial and dental injuries were caused from a blow of a stick (Daly, 1990). Nearly two-thirds of the 29 lacerations reported by Lorentzon et al. (21.8 per 1000 player-game hours) were caused by players being struck with the opponent's stick. The low rate of head, face, and neck injuries (1.1 per 1000 player-game hours) reported by McKnight et al. was attributed to the required use of helmets with full facial protection in intercollegiate hockey (Stuart, 1995). Lorentzon's data regarding high facial injury potential is due to the fact that the athletes used in his study were required to wear facial protection (Lorentzon, 1988). There is little doubt among hockey players that wearing a helmet and a face guard reduces major face and head injuries (Pashby, 1977).

The blade of the stick, even though its capacity of lacerating tendons, nerves, and blood vessels makes it a potentially dangerous piece of equipment, has been reported to be involved in only 3% to 6% of injuries (Sim, 1989). During a study by Tegner and Lorentzon (1991), of 12 Swedish Elite hockey teams, only four injuries (or 1.5% of total injuries) occurred due to contact with a skate blade (Tegner, 1991).

Stamina and endurance also played important factors in avoiding injury (Daly, 1990). Lorentzon et al. (1988) noted a gradual increase in injury rates as the game progressed. Twenty-seven percent of injuries occurred during the first period, 30% during the second period, and 36% during the third period. Daly (1990) noted that a player's stamina diminished slightly as the game progressed, and the ability to avoid impact may have diminished.

Epidemiology

An injury is defined, as any event that kept a player out of practice or competition for any minimum of time, required the attention of a physician or athletic trainer, and included all dental, eye, nerve, and concussion injuries (Stuart, 1995).

Several studies on the epidemiology of ice hockey injuries have been reported. Because of the non-uniform patterns of injury reporting, injury definition, and the definition of the player population at risk, interpretation and comparison of different studies is difficult (Daly, 1990). Also, player age, skill level, and type of protective equipment worn may have dramatically affected injury statistics (Daly, 1990). Factors that were of most interest in many injury studies were injuries that occurred during a game versus a practice and the position that the athlete played.

There was a greater risk of injury in ice hockey competition as compared to a practice (McKnight, 1992). Collegiate male hockey players were 25 times

more likely to be injured in games than in practice (Stuart, 1995). The reason for these statistics was believed to be due to the added physical nature of competition or games. Statistics showed that practice injury rates were higher in the first third of the season than in the final two-thirds of the season. This may have been attributed to athletes feeling burn-out and boredom with practice sessions as compared to the excitement and do-or–die attitude that is associated with competitions. No difference was found in game injury rates during each third of the season. The game injury rate was higher in the third period as compared to the first and second periods (Stuart, 1995). The higher rate in the third period may have been explained by third period fatigue and aggression (Stuart, 1995).

The cause of the majority of ice hockey injuries was due primarily to physical contact between players, while failure of equipment and non-contact activity were less frequent causes of injury (Sim, 1987). Most injuries occurred from direct trauma (about 80% in male collegiate ice hockey players), such as checking and stick interaction, while 20% were due to indirect forces resulting in overuse patterns (Daly, 1990). The direct trauma injuries were broken down into three major areas: collisions with other players, stick injuries, and the puck (Sim, 1987).

Ice hockey injury rates were different among players of different positions. The goalies demonstrated the lowest injury rate of all positions. This may have been attributed to the added worn protection, the relatively limited

playing space and/or the limited body contact that they engaged in (McKnight, 1992). Consideration also was given to the limited number of athletes who played this position, along with the decreased amount of exposure compared to other positions (Jorgenson, 1986).

Data indicated that forwards (wingers and centers) had the highest number of recorded injuries. Forwards having the largest number of recorded injuries was due to the fact that they were the most represented position on the ice at one time (Pelletier, 1993). Stuart's data stated that between forwards and defenders, forwards suffered two thirds of all injuries among this group of players (Stuart, 1995). The severity of injuries between forwards and defenders was the same. Both positions involved high-speed collisions with opponents, boards, and the ice. Forwards suffered the highest rate of injuries to all body areas except the groin, hip, and thigh. Defenders had the highest rate of injury in this area (McKnight, 1992) possibly because they tend to use there body (especially the lower body) more to block opponents and pucks.

Anatomical Sites

Head and neck. Neck injuries varied from minor sprains to severe fractures with spinal cord involvement resulting in paralysis (Sim, 1989). Serious head and neck injuries have been associated with the game of ice hockey. The primary mechanism involved neck flexion and significant compression loading as a result of head-first collisions with other players or the

boards (Gerberich, 1987). Head injuries accounted for one team injury per every 10th game (Bahr, 1995).

The types of other head injuries that occurred in the game of ice hockey have ranged from mild concussions to a neurosurgical emergency such as an epidural hematoma (Daly, 1990). Although the use of helmets reduced these types of closed head injuries, helmets were associated with an increased incidence of cervical spine injuries (Tator, 1984). Some authors claimed that the helmet had been used as an offensive weapon, as well as it encouraged more aggressive play and subsequent cervical injuries (Daly, 1990). Until recent years, not all hockey leagues required the use of the helmet and face masks. Even with the use of the helmet, there had been reports of severe brain injury, even death (Sim, 1989) in the sport of ice hockey.

A concussion has been a very common injury to the game of ice hockey. A concussion has had many definitions. Some medical practitioners argued whether or not a person had to loose consciousness to actually suffer a concussion. Sim (1989) defined a concussion as "any loss of consciousness after a head injury." The player was then removed from the game and observed closely. Symptoms of a concussion ranged from "seeing stars," being dizzy or nauseous, having a mild headache, mild confusion, amnesia, and loss of consciousness (Sim, 1989). If an athlete complained of any of these symptoms after being hit in the head, a concussion was suspected.

Eye and face. Even though helmets were made mandatory at every level and masks were required at all levels of hockey, expect professional, face and eye injuries still occurred. Facial injuries were mainly caused by stick contact, although Bahr (1995) found that a large number of injuries occurred when the helmet was tipped upward or downward following a collision with another player or the boards. Wearing a helmet was still found to expose the chin to lacerations as well as cutting the bridge of the nose when the helmet was tipped forcibly on to it (Sim, 1990). Being that the stick was the most common cause of these facial injuries, rule changes brought on the enforcement of high sticking penalties (Daly, 1990).

Fractures of facial bones were usually caused by direct injury from the puck. The use of face masks was successful in decreasing the frequency and severity of these injuries (Sim, 1989). As noted previously, fast moving pucks and swinging sticks have caused masks to depress, making facial contact, which resulted in facial fractures (Bishop, 1976).

Direct blows to the throat can lead to serious difficulty breathing. The throat was an area of vulnerability, particularly in goal tenders. Most goalies reported wearing protective collars to avoid such injury (Sim, 1989).

Since the mandating of face masks, eye injuries have been shown to decrease in severity and frequency. Most data regarding orbital injuries was collected prior to the mandatory face mask era. Pashby (1977) reported that the

most frequent eye injuries were soft tissue, hyphaema, and iris damage. This resulted in a big push for mandatory face masks (Pashby, 1977).

Upper extremity. The shoulder was reported as a highly abused joint in the game of hockey, particularly at the collegiate level where aggressive checking caused frequent direct blows to the shoulder girdle (Daly, 1990). Injuries to the upper extremity resulted from repetitive shooting of the puck and, also, blunt trauma (Sim, 1989).

Shoulder separation, or acromioclavicular joint separation, was also a common injury in the game of ice hockey. It was generally caused by indirect trauma such as a fall on an out stretched arm (Daly, 1990). Other causes, as reported by Sim et al. were direct blows to the shoulder when a player was checked into the boards by another player. The injuries which were caused by high speed collisions, were hard to prevent because it was difficult to fit shoulder pads in a way that effectively alleviated acromioclavicular (AC) joint loading (Bahr, 1995). Disability varied with the severity of the injury. Grades I and II were considered minor to moderate sprains with little disruption of the supporting shoulder girdle structures (Sim, 1989). Total time lost due to AC separation ranged from a few days to 2 weeks (Bahr, 1995). Grade III AC separations usually showed obvious visual deformity and loss of function due to supporting structure damage (Sim, 1989). An athlete could expect to miss 3 to 6

weeks of activity, depending on if the injury was treated surgically or not (Bahr, 1995).

In hockey players, a dislocated shoulder, although less common than a separated shoulder, was a cause of moderate to severe disability. A blow that forced the arm outward and backward (abduction and external rotation) caused the head of the humerus to be pushed forward, resulting in a tear of the anterior joint capsule (Sim, 1989). Those dislocations had significant morbidity, often causing not only joint capsule tears but a tear of the anterior labrum of the joint (Bankart lesion) (Daly, 1990).

Recurrence of a dislocation was reported to be common once the injury occurred. Dislocations of the shoulder indicated 4 weeks of immobilization plus 4 to 6 weeks of strength exercises before return to play was granted. Often surgical fixation was necessary to correct dislocations or subluxations (incomplete dislocation) before a player could return to activity (Sim, 1989).

Elbow, wrist, and hand injuries have also affected a hockey player's season. Fractures of the scaphoid bone, the most commonly fractured metacarpal, were caused by a fall on a dorsiflexed wrist (Sim, 1989). The scaphoid required a long time to heal, often being casted up over the elbow for nearly 2 months (Daly, 1990).

Injuries to the hand and elbow were less common in ice hockey as compared to other parts of the body. Gloves and elbow pads better protected these areas of the body. In professional hockey games, as well as some

collegiate games, hand fractures and lacerations were commonly seen. This was due to the frequency of fighting during play. The lacerations that were reported often caused the spread of bacteria (from mouth lacerations) thus requiring immediate care and cleaning (Sim, 1989).

"Gamekeepers Thumb" was also a commonly reported ice hockey injury. It was defined as a player falling with their stick in-hand, causing the adduction force on the metacarpalphalangeal joint of the thumb and rupturing the thumb's ulnar collateral ligament (Daly, 1990). This injury was considered important to recognize because it was considered severe and usually required surgical fixation (Sim, 1989).

Low back. Bahr (1995) stated that low back pain was the most common reason for missed time in amateur hockey, though most cases of low back pain were minor. Daly found that the lower back pain was often disabling when it did occur. Pain was assessed most often in the lumbosacral region and was usually caused by hyperextension movements such as when a player was checking or hitting the boards (Sim, 1989). Such pain was most often muscular in nature (Daly, 1990), but could also have resulted from reactions to abnormal stress on the posterior spinal elements such as acute spondylolysis (Sim, 1989). Spondylolysis is defined by Tabor's Medical Dictionary as the breakdown of a vertebral structure. Daly (1990) suggested that once a lower back injury was

assessed an adequate back and abdominal strength program was prerequisite to rehabilitating and/or preventing back injuries.

Lower extremity. In hockey, injuries to the lower extremity predominantly involved soft tissues. The groin was a very common site of muscle strain because the main thrust of the skating stride involves a forceful contraction of the hip abductor and extensor muscles. This injury accounted for up to 10% of total team injuries (Lorentzon, 1988). Sim et al. (1989) found that groin injuries were often severe and limited the athlete's ability to play. Data showed that groin injuries were especially common in goalies. Other players were frequently affected, though goalies tended to report the most groin (or hip flexor) injuries as their position requires them to perform amazing acrobatic and flexibility maneuvers while standing, sitting and lying on the ice. Among skating positioned players, groin injuries were the result of acute strains, where the leg was forcefully abducted, or from overuse during skating (Bahr, 1995).

Soft-tissue injuries were common in ice hockey. A disabling contusion to the pelvis was referred to a "hip pointer," in which a hematoma formed at the iliac crest. A contusion in this area was carefully examined as not to be mistaken for a muscle tear or a fracture of the iliac crest (Sim, 1989).

Contusions of the thigh were common and usually occurred from direct trauma when a player strikes a goal post or an opponent's knee (Daly, 1990). Loss of knee flexion as a result of the formation of a hematoma with swelling in

the thigh required 4 to 8 weeks to resolve, depending on the severity, according to Sim's 1989 study.

Daly (1990) found that knee injuries in ice hockey usually involved sprains of the collateral ligaments, but damage to the anterior cruciate ligament also occurred. Collateral injuries in ice hockey occurred when a player struck another player's flexed knee, from the medial or lateral side, causing a combined valgus or varus and rotational injury (Sim, 1989). The most common, severe, knee injury in ice hockey was reported to be the complete rupture of the medial collateral ligament (Lorentzon, 1988). Most tears of the collateral ligaments were treated non-operatively, but only after ruling out damage to other supportive knee structures, including the anterior cruciate ligament and menisci (Daly, 1990).

At times, the anterior cruciate ligament was also injured. Treatment was either non-operative, or it involved operative ligament reconstruction (Sim, 1989). The mechanism tended to be similar to when the collateral's were damaged; anterior cruciate ligament tears involved more rotation and less flexion of the knee.

Ankles and feet also risked injuries in ice hockey. Ankle sprains were actually uncommon. The stiff protective skate boot usually protected against inversion of the ankle. The sharp blade, however, caused tendon and vessel lacerations in the ankle area where the skate boot left the skin and ankle unprotected (Hovelius, 1979).

Fractures to the metatarsals, or toes, were a very commonly reported foot injury in ice hockey. They usually resulted from a blow to the foot, as from a hockey stick or a fast moving puck (Sim, 1989).

Prophylaxis. Vinger (1977) claimed that the main purpose of studying injuries and injury patterns in ice hockey was to identify factors that may prevent injuries. Overall, an injury among hockey players was accepted as part of the game.

Over the past several years, as a result of many injury studies, new rules and better equipment were introduced to help cut down on unnecessary injuries in hockey. Protective equipment soon became mandatory at all levels of play. Sim et al. (1987) reported that players older than 12 years of age must use a face mask with an internal mouthpiece. Helmets greatly reduced the incidence of closed head injuries. Adequate shoulder padding and padded hockey pants also helped reduced the number of contusions of the shoulder, hip, and thigh (Daly, 1990).

Next, establishment of effective rules and their enforcement was shown to significantly decrease injury rates. As many as 39% of all ice hockey injuries were attributed to foul play (Lorentzon, 1988). One opinion stated that closer officiating and distribution of penalties for high sticking and elbowing could decease facial injuries. It further stated that penalties for cross-checking, especially from behind, needed to be more enforced because this hit usually

involved the recipients' head being down at the boards thus causing extreme and devastating hyperflexion and a cervical spine injury (Daly, 1990).

Lastly, the prevention of injuries in ice hockey could be based on proper training and conditioning, as well as good coaching. Proper coaching could help young skaters become aware of potential injuries and how to avoid them (Sim, 1987). Strength training was also shown to be an important factor. Daly (1990) suggested that the strengthening of cervical muscles in the upper torso also helped in preventing neck and shoulder injuries.

Chapter III

METHODOLOGY

The purpose of this study was to gather and analyze data regarding Men's and Women's Division I ice hockey injuries, what caused these injuries, how often they occurred, and how much time, if any, was lost from participation due to the injury. Data were collected with the intention to help athletic departments plan for a sufficient medical staff, inform coaches and players of the injuries most common to the sport of ice hockey, and plan an injury prevention program for their athletes.

Participants

Members of both the men's and women's Division I ice hockey teams at St. Cloud State University (1998-1999 season only) were asked to participate in this study. The study involved 43 St. Cloud State University athletes, 22 men and 21 women. The entire women's team participated in this study. Twenty-one of 26 men decided to participate in the study. Supporting injury data were requested from The University of Minnesota and The University of New Hampshire Division I women's ice hockey programs. A grand total of 85 athletes participated in this study

A participant was defined as an athlete who maintained candidacy for varsity competition by subscribing to the teams eligibility rules and requirements

The start of the season was defined as the first regular scheduled practice under the direct supervision of a coach as allowed by the NCAA. The end of the regular season was defined as the conclusion of the competitive season, not including any playoff season.

Instrument

A certified athletic trainer was responsible for collecting data and reporting injury and exposure rates. The sports medicine injury form used was standard for St. Cloud State University with the following variables: male or female team member, injury date, extremity or body part, injury type, cause of the injury (stick, collision, etc.), player position, session type (practice, game, period number), and number of practices or games missed.

Procedures

A request was made to the Institutional Review Board for the Protection of Human Subjects for exemption from full review, which was granted on March 18, 1999.

A packet was given to every eligible participant of both the men and women's 1998-1999 Division I ice hockey team at St. Cloud State University. The packet contained a cover letter explaining the purpose of the study, the procedures involved in the study, as well as the subjects' role in the study. Also

included in the packet was a "consent to treat" form that all intending to participate needed to sign. This was necessary for the release of each individual subject's 1998-1999 medical information. The deadline for the return of the consent forms was April 2, 1999.

Analysis of Data

All injury reports were grouped by male and female participants, then further divided by injury type, the cause of the injury, player position, and the amount of time lost from participation (in player-hours). Results will be posted as percentages and frequencies. Statistical analysis was done utilizing the services of St. Cloud State University Academic Computer Services Department.

Chapter IV

RESULTS

This study compared injuries among Division I Men and Women's ice hockey players. Data were collected from athletic trainers at select Division I schools and included how that injury occurred, body parts injured, player position, when the injury occurred and the amount of playing time the player lost due to the injury.

Three schools supplied data regarding women's ice hockey injuries, as well as the men's ice hockey team at one Division I school. All female athletes released their injury history from three different Division I teams for the study. Twenty-one of 26 (85%) male athletes from one Division I team released their medical history for the study (Table 1).

Table 1

Total Number of Participants

	# of Team Members	# of Participants	%
SCSU Men	26	21	80.8%
SCSU Women	22	22	100.0%
University of New Hampshire	21	21	100.0%*
University of Minnesota	21	21	100.0%*

*Assuming all athletes participated

An injury was defined as an event that caused the athlete to miss part of a practice or game. A total number of 135 injuries were reported. Fifty-five of the total injuries reported were suffered by male hockey players or 2.6 injuries per player.

The women reported 80 injuries total. Thirty-one injuries were reported by St. Cloud State University or 1.25 injuries per player. Thirty-three injuries were reported by the University of Minnesota and 16 at the University of New Hampshire (Table 2).

Data collected show men suffered 2.6 injuries/player overall compared to the women (1.25 injury/player).

Table 2

Total Number of Hockey Injuries

	SCSU	University of MN	University of New Hampshire	Total
Gender				
Women	31 (1.25 Inj/player)	33	16	80
Men	55 (2.6 Inj/player)	N/A	N/A	55
Total	86	33	16	135

Injuries were broken down into three categories of occurrence: collision, non-collision and injuries caused by other objects. Collision injuries were those that happen after contact with another player, the boards, or when pushed into the goal post by another player. The other objects that usually cause injuries in

ice hockey are pucks, sticks and skates. Non-collision injuries were any injuries that occurred without incidence with another player or object as well as over use injuries that may have occurred over multiple numbers of playing sessions.

During this study, 55% of injuries were due to collision with another player, the boards, ice or goal posts. The women reported 43 (.67 inj/player) and the men reported suffering 31 (1.47 inj/player) collision injuries.

Among all hockey injuries, 29% were reported as non-collision. The women suffered 22 (.34 inj/player) of these injuries and men reported suffering 17 (.81 inj/player) non-collision injuries (Table 3).

Table 3

Identifiable Ways that Hockey Injuries Occurred

	Collision	Other Object	Non-Collision	Total
Gender				
Women	43 (.67 inj/player)	15 (.23 inj/player)	22 (.34 inj/player	80
Men	31 (1.47 inj/player)	7 (.33 inj/player)	17 (.81 inj/player)	55
Total	74	22	39	135

A smaller number of hockey players were involved in injuries that were caused by other objects. Of the 16%, 15 (.23 inj/player) were women and only seven (.33 inj/player) were men.

When comparing how injuries occurred among St. Cloud State University women and men, there was not a significant difference. The men did not suffer injuries in any different way when compared to the women hockey players, and overall, the men suffered more injuries than the women.

When reviewing data in regards to female athletes only, collision injuries were the most prominent. Collision injuries accounted for 54% of all injuries. Medical records also show that all women suffered 19% of injuries caused by other objects and 27% were non-collision injuries (Table 4).

Table 4

Occurrence Types of Women's Injuries

School	Collision	Other Object	Non-Collision	Total
SCSU	20 (.42 Inj/player)	5 (.10 Inj/player)	6 (.13Inj/player)	31
University of NH	10 (.48 Inj/player)	2 (.10 Inj/player)	4 (.19 Inj/player)	16
University of MN	13 (.62 Inj/player)	8 (.38 Inj/player)	12 (.57 Inj/player)	33
Total	43	15	22	80

Certified Athletic Trainers were also asked to provide information on the type of injuries that their athletes suffered. Injuries were broken down into three categories: soft tissue injuries, head/neck injuries and injuries involving bone/joint. Of the reported 55 in-season injuries by men, 53% of the injuries were classified as soft tissue. In addition, they suffered 13% head and neck injuries and 34% bone and joint injuries.

The women reported a total of 80 injuries overall. Female athletes totaled 38% of their injuries as soft tissue. The women also reported 17% head and neck injuries and 45% bone and joints injuries.

The women did not suffer any more soft tissue injuries than the men [X^2 (2) = .016, P > .990]. No difference was found among female and male hockey players with head and neck injuries [X^2 (2) = 2.32, P > .25]. All women, however, suffered significantly more bone and joint injuries [X^2 (2) = 5.24, P >.05], when compared to the men.

The University of Minnesota women accounted for the most soft tissue injuries with 60% as compared to St. Cloud State's 23%. St. Cloud State reported the most head and neck injuries with 64%, which was 29% of their overall total injuries. The University of New Hampshire reported four head and neck injuries or 25% of their overall injury total. The University of Minnesota had the lowest number of head and neck injuries with one. St. Cloud State reported the most bone and joint injuries compared to other Division I ice hockey programs (Table 5).

Table 5

Injury Types by Gender

	Soft Tissue	Head/Neck	Bone/Joint
SCSU Men	29 (49%)	7 (33%)	19 (35%)
SCSU Women	7 (12%)	9 (43%)	15 (27%)
University of NH Women	5 (8%)	4 (19%)	7 (13%)
University of MN Women	18 (31%)	1 (5%)	14 (25%)
Total	59	21	55

Athletes were asked how much playing or training time they lost due their injury. Some never required rest or time off. The most time lost due to injury was 65 days, or the end of the regular season, whichever happened first (Table 6).

Table 6

Time Lost from Hockey Due to Injury

	0 Days	1-6 Days	7-14 Days	>14 Days
Women	42	27	5	5
Men	24	16	6	8
Total	66	43	11	13

All men reported that 36% of their injuries required zero days away from play or training. The women reported that 64% of their injuries resulted in no time lost from activity. When using relative injury rates to the number of male and female subjects, the men were significantly more likely to miss playing time due to a hockey injury, [X^2 (2) = 4.9, P < . 05]. Individually, however, there was

no significant difference between the men and the women who lost 1-6 days of hockey due to injury [X^2 (1) = 2.8, P < .10], 7-14 days away [X^2 (1) = .384, P > .50] and more than 14 days away from activity [X^2 (1) = .692, P > .25]. Overall, the men were nearly twice as likely to miss at least 1 day of activity with 1.5 injuries player as compared to the women suffering .6 injuries per player.

St. Cloud State University injury data also reported the position in which the athlete played on the ice. All athletes were categorized as offense, defense, or goalie. St. Cloud State University alone reported 63% of 135 total injuries. All other schools did not supply information based on player position.

Thirteen percent of all injuries were reported by goalies at St. Cloud State University. The female goalies reported 64% of all injuries and the men reported suffering 36% of all injuries at the same position. There was not a significant difference among the injury rates of male and female goalies [X^2 (1) = .818, P > .50].

Defensive players suffered 39 (45%) of the 86 overall reported injuries at St. Cloud State University. The women reported 41% and the men reported 59% of injuries by defenders (Table 7).

Table 7

Injury Rates by Gender and Position

	Offense	**Defense**	**Goalie**	**Total**
Women	8 (.31 Inj/player)	16 (.62 Inj/player)	7 (.27 Inj/player)	31
Men	28 (1.27 Inj/player)	23 (1.05 Inj/player)	4 (.18 Inj/player)	55
Total	36	39	11	86

There were 36 (42%) reported injuries by offensive hockey players at St. Cloud State University. The women reported only 26% of their injuries as offensive compared to the men's 51% offensive injuries. The men had a significantly higher number of offensive injuries. There was a statistically higher rate of injury for male offensive hockey players [X^2 (2) = 11.1, P < .05].

Chapter V

DISCUSSION

Today more than 1,950 athletes are playing Division I College Ice Hockey and 472 of them are playing on women's teams (NCAA, 2003). As more and more women's Division I programs are forming across the country, injury potential is on the rise. With this increased interest in the sport, the sports medicine community has shown interest in determining the injury types and rates as well as prevention plans among Division I Ice Hockey players. Of particular interest is the incidence (rate) of injuries (Noyes, 1988).

During this study 85 Division I players accounted for 135 injuries. Male ice hockey players suffered 41% (55) of these injuries; the women reported 59% (80) of these injuries. The St. Cloud State University women alone recorded 31 of the 80 injuries reported by all three women's teams. Lack of studies on women's ice hockey injury rates fail to support or refute the results from this study. Though, Powell (personal interview, 1998) believes that based on injury surveillance of Division I men's ice hockey that women's injury rates should be reduced by 15-20%. This would be due to the fact that the women's game is not nearly as fast and physical as the men's game as well as the 'no-check" rule

in women's hockey. This study did find that the men reported more collision injuries (1.47 inj/player) when compared to the women (.67 inj/player).

The 135 injuries reported here were divided into three groups: collision, non-collision and those caused by another object (such as pucks, stick blades and skates).

In this study, 31/55 (56%) of the men's injuries were a result of collisions. Walkden and Stuart reported that most injuries are a result of collisions. This is believed to be a result of body checking in men's ice hockey as well as the overall speed of the game. The reason for the women suffering nearly equal percentages (54%) of collision injuries, in spite of the "no-check" rule, may be attributed to their lack of skill and strength when compared to their male counterparts. Walkden (1998) speculated that women's injuries may be a result of poor technique and defensive maneuvers as a result of the relative newness of the sport itself.

As expected, non-collision injuries occurred less than collision injuries. Of the 39 reported non-collision injuries, the women suffered 22 (.34 inj/player) and the men reported 17 (.81 inj/player). Sim (1989) and Lorentzon (1988) found that high magnitude muscle forces found in quick acceleration and deceleration predispose a hockey player to collision and non-collision injuries. Daly (1990) reported that 20% of male, collegiate, hockey injuries were a result of indirect forces or overuse patterns.

Women's injuries that were reported in this study tended to be a result of indirect trauma (overuse) as well as those that occurred in off-ice conditioning as compared to the men who tended to suffer more direct trauma. These results are likely due to the women's inexperience with the game as well as their relative size and strength differences when compared to the men.

As expected, both the men and the women experienced injuries because of other objects (pucks, stick blades, and skates). The women reported 15 injuries compared to the men's seven injuries. On average, 16% of all injuries reported in this study were due to other objects (women = 19% and men = 13%). Sim's (1989) data states that 15-20% of all ice hockey injuries are a result of overuse.

Throughout this study it has been found that the women suffered a larger than expected number of collision injuries (.67 inj/player). Even though the rules of the game vary a little bit between men's and women's ice hockey and even though the women are not allowed to use body checking their game is still aggressive by nature. Walkden (1998) has suggested otherwise, stating that the slower paced women's game produces less collision injuries, especially those serious in nature. Data from this study would suggest that the "no-check" rule for women should remain in place. Because of the higher than expected number of women's collision injuries, athletic training coverage for women should be the same as athletic training coverage for men. If all collision injuries can not be prevented, all should be treated the same, regardless of gender.

One other reason for a higher number of women's injuries may be due to lack of experience. Many men have been playing ice hockey since their childhood with many years of training and coaching to help develop their skills. This is not the case for many female players at the collegiate level. Many women at this level have diminished experience, lack upper and lower body strength as well as inadequate endurance to play high intensity hockey.

Defenders of both genders, at St. Cloud State University suffered equally high incidences of injury among all players on the ice with a total of 39 injuries. The men recorded 42% and the women 51% of all injuries. Stuart (1995) on the other hand, reported that forwards (offense) tend to be injured the most, due to the fact that the offense has more players on a team than defenders and goalies. But McKnight (1992) stated that defenders had the highest incidence of hip, groin and knee injuries. This is explained by the fact that defenders use their body, especially the lower body, more for direct contact with opponents, the ice and pucks. These mechanisms of injury have lead to increased musculoskeletal injuries at the hip, groin and knee. This leads to the conclusion that emphasis on injury prevention for the lower body should be stressed for defenders, regardless of gender for Division I collegiate hockey players.

As previously stated, Stuart (1995) reported that forwards (offense) were the highest injured position on the ice. This was not the case with St. Cloud State University ice hockey players. Forwards reported a total of 36 overall injuries, three less than defenders. Of these 36 injuries, the men reported a

significantly higher incidence of offensive injuries with 55 (51%) compared to the women's eight (26%). The higher number of injuries for males forwards maybe attributed to the fact that they are allowed to check and their game is more physical.

Injuries were classified under three categories: soft tissue, head and neck, and bone and joint. St. Cloud State University female hockey players reported that the majority of their injuries as bone and joint with 15 (48%). The men's dominant injury, on the other hand, was soft tissue with 29 (53%) reported. The increased number of soft tissue injuries is supported by data that Sim (1989) collected. He stated that high acceleration and deceleration forces combined with dynamic stability requirements on the ice expose the hockey player to soft tissue injuries, specifically hip flexor and hip extensor strains. Because the men skate with more force and faster than the women and because the men also tended to use their bodies for more person-to-person contact, the men are pre-disposed to more soft tissue injuries.

The increased number of bone and joint injuries among female ice hockey injuries, when compared to men, may be a result of repetitive falls or ill-contact with another player (Even though the men experience both, the men tend to be stronger and better conditioned as compared to the women). Daly (1990) reported that many bone and joint injuries were a result of direct trauma such as falling on an outstretched arm resulting in a shoulder, elbow and wrist injury.

This study found that many of the women's bone and joint injuries were also a result of weight room injuries and off-ice conditioning injuries.

Both genders reported head and neck injuries. This was the highest reported injury type among the women in this study with nine (29%). The men only reported seven (12%) head and neck injuries. This may be due, in part, to the men being stronger and more experienced in body contact when compared to the women. One other reason for the increased number of head and neck injuries among women is that they may be more likely to report them to sports medicine staff when compared to the men. The men, with their "play tough through any situation" attitude, may be more inclined to deny injury or symptoms in an attempt to stay in the game rather than sit it out.

Generally it is believed that women's ice hockey skills have improved over the years. As popularity for the sport grows, early induction of proper and intense training, appropriate coaching and increased commitment are expected to shift the cause of injuries in women's ice hockey from inadequate technique and conditioning to game intensity and pace. Walkden (1998) also believes that if checking remains out of play for women, it is likely that women will not see the number of serious head and neck injuries that are more common in men's play.

Chapter VI

CONCLUSIONS AND RECOMMENDATIONS

Ice hockey has become increasingly popular at all levels of play. Recently, ice hockey has expanded to include girls and women of all ages. It is assumed that females will be predisposed to the same injuries that the men suffer. With more women playing hockey, sport medicine staffs are expected to prepare for sport and gender specific injuries. This study provides important information about injury types, rates and differences among Division I male and female ice hockey players.

Conclusions

The following conclusions can be drawn from this study:

1) Overall, division I male ice hockey players suffer more injuries than the female Division I ice hockey players.
2) More than half of all injuries are due to collision with other players, the boards, ice or the goal post. Men incur nearly twice the risk of experiencing a collision injury compared to women.
3) The reason for the women suffering nearly equal percentages (54%) of collision injuries, in spite of a "no-check" rule can be attributed to

their lack of skill and strength when compared to their male counterparts.

4) When comparing injury types among St. Cloud State University men and women, the women suffer more bone and joint injuries with 15 (48%) and the men suffer more soft tissue injuries with 19 (53%).
5) There is no difference in injury rates for defenders between genders. Male offensive players receive more injuries than female offensive players
6) The men are more likely to miss at least one day of activity due to injury with 1.5 inj/player when compared to the women suffering .6 inj/player.

Recommendations

Injury is an inevitable and accepted part of ice hockey. Vinger (1977) reported that the main purpose of studying ice hockey injuries and patterns was to identify ways to prevent the very same injuries. As a result of many studies, both new rules and better equipment have been introduced and mandated at all levels of hockey. For example, 39% of all injuries are a result of fowl play (Lorentzon, 1988) and helmets have been shown to greatly reduce closed head injuries. The following are recommendations for additional research in the area of understanding, preparing for, and the education of ice hockey injuries among

men and women, especially at a competitive level such as collegiate ice hockey:

1) When determining appropriate sports medicine coverage for collegiate hockey teams, gender should not play a role. This game is nearly identical and injury rates, types and severity are similar between genders. It is recommended that men and women have the same day-to-day coverage with emphasis on injury prevention.
2) More emphasis on off-ice strength and conditioning sessions is needed to decrease over-all injuries. Special attention needs to be given to the hip extensors, rather than the hip flexors, as they are one of the most injured and under trained parts of a hockey player's body.
3) Coaches, players and athletic trainers must work together closely in preventing injuries. A team approach will be most successful. Each individual has unique experience and knowledge that can help in training and prevention.
4) Protective equipment needs to be continuously studied in order to provide the best possible protection for hockey players.
5) Establishment of effective rules and enforcement can significantly decrease injury rates as a large number of injuries are a result of fowl play.

6) Body checking should be kept out of women's ice hockey in order to prevent serious head and neck injuries.

7) Additional studies of comparisons of men's and women's division I ice hockey should be pursued by the sports medicine community in order to determine if injury rates and types among genders has changed, especially as women become stronger, faster and more experienced in ice hockey.

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APPENDIXES

APPENDIX A

Letter of Exemption from the Institutional Review Board for the Protection of Human Subjects

SCSU Office of Sponsored Programs
Administrative Services 210
St. Cloud, MN 56301-4498
E-MAIL: OSP@TIGGER.STCLOUD.MSUS.EDU

(320) 255-4932
FAX: (320) 654-5292

TO: Rachel Lynn Muellner Johnson

FROM: Susan Jensen-Cekalla
David Bacharach

DATE: March 18, 1999

RE: IRB Proposal: Ice Hockey Injuries in Men's and Women's Division I Ice Hockey

We have received your application to the Institutional Review Board for the Protection of Human Subjects. Your project meets one or more criteria for exemption from full committee review.

Your research project is approved when the following conditions have been met:

1. Add your advisor's name and phone number in the consent form.

(The researcher must respond to these concerns before proceeding with the research)

****

This letter signed on behalf of the Institutional Review Board and the University, signals the researchers that the project has been exempted from IRB review. The researcher(s) should be aware that any changes in the research plan must be reported to the IRB (contact the Office of Sponsored Programs with the proper revisions). The IRB also reserves the right to follow up while the research is in progress or after the research has been completed.

Congratulations. We wish you well with your research.

For the Institutional Review Board:

Susan Jensen-Cekalla
Director, Grants Development & Administration
Office of Sponsored Programs

For St. Cloud State University

Dennis Nunes
Dean, Graduate Studies

cc: File

APPENDIX B

Letter to Athletic Trainers and Injury Report List

1520 East Hwy 23 #208
St. Cloud, MN. 56304
April 9, 1999

Dear Women's Hockey Athletic Trainer,

My name is Rachel Johnson. I am a graduate assistant athletic trainer at St. Cloud State University. I am currently working towards the completion of my thesis. The focus of my study is to compare injury rates, injury types, the causes of these injuries and the amount of time lost from activity due to injury, between men's and women's Division I ice hockey injuries. I am interested mainly in data from St. Cloud State University men's and women's hockey teams. Because our women's team is in their first year of existence, I have been advised to collect data from other women's teams that have been established for a few years or more. This will be done to strengthen my women's data.

I would appreciate if you could help my by sending me some information on your women's 1998-99 ice hockey injuries. I am interested in the official regular season only. I am not including playoff data in my study. All information received will be analyzed as a group only. Your confidentiality is assured and no individual school will be identified. The results will be used in my thesis only. My goal is to determine if a difference occurs between men and women's Division I ice hockey injuries, injury rates, the causes of these injuries, as well as the time lost from activity due to injury. I am also interested in being able to predict injuries at both levels of hockey. I feel that this is important due to the fact that very little data exists on women's and girl's ice hockey injuries.

It would be most appreciated if you could complete the enclosed form and return it in the self addressed stamped envelope by May I, 1999. Mailing the completed injury report will end your obligation for further participation. Please feel free to inform me if you would be interested in obtaining the results of the study. I would be happy to send them to you. If you have any questions regarding this study, feel free to contact me at (320) 203-8017 or at work at (320) 255-2597. My advisor, Dr. Robert Waxlax, is also available for consultation at (320) 255-3176.

Thank you for your time and participation. I truly appreciate your help in collecting data. I look forward to receiving your early response.

Sincerely,

Rachel Johnson ATC/R

Enclosures

Women's Division I Ice Hockey Injuries

Please complete this form to the best of your ability. Any amount of information that you can give will be helpful. I realize that this is very specific information that you may not normally collect. Please use the following injury definition when completing this form. Feel free to attach additional copies if necessary.

Injury: any event that keeps a player out of practice or competition for any minimum amount of time, requires the attention of a physician or athletic trainer, and includes all dental, eye, nerve injuries, and concussions.

Injury type (MCL, etc).	**How injury occurred (Stick, collision, over-use, etc)**	**When it occurred (game, practice, period #, etc.)**	**Amount of time lost from activity (# of practices, # of games)**

APPENDIX C

Letter to Athletes, Study Description and Release of Medical Information

Dear Athlete,

My name is Rachel Johnson and I work as the women's hockey athletic trainer at St. Cloud State University. I am currently working on the completion of my Master's Degree and my Master's Thesis. The topic of my study is to examine the relationship between men and women's Division I ice hockey injuries.

In order to complete my study, I need to have access to your 1998-99 hockey related injury reports for my data. Your reports as well as your name will always remain confidential. The following consent form explains my intentions as well as my procedures for documentation that will be used. Please read the attached cover sheet thoroughly and sign the second sheet (only if you plan to participate). Please only give me the signed consent form back. If you do not plan on participating in the study, please print your name on top of the packet and return it to me. **I would like all consent forms** (signed or unsigned) **back by Friday, April 2, 1999.**

Thank you for your time and consideration.

Sincerely,

Rachel Johnson ATC/R
Women's Hockey Athletic Trainer

You are invited to participate in a study of Division I college hockey injuries and injury rates. I hope to learn if a relationship exists between men and women's Division I college ice hockey injuries, injury rates and the amount of time spent out of the game due to these injuries. This is of interest to the sports medicine community for the purpose of helping to prepare for and prevent unnecessary injuries. You were selected as a participant in this study because of your status as a Division I collegiate ice hockey player.

If you decide to participate, the researcher and associates will observe and record all injuries attained in all official team workouts (including, but not limited to: on-ice practice, weight-room activities, off-ice training, scrimmages and games). Injuries that will be documented are any that require the attention of the athletic trainer and/or team physician as well as those that require any form of treatment (including, but not limited to: ice, heat, electric and other related modalities, taping, bracing and rest from participation). Not only will the type of injury, its cause, and when/where it occurred be documented, but also day to day playing status will be documented. The researcher(s) are particularly interested in when a player needs to be held out of practice due to injury. As the athlete, you will not be expected to answer any additional questions regarding your injury other than the standard questions asked during the evaluation and day to day follow up (including, but not limited to: when, where, how did it happen? Do you have any history of this injury?). You will not be required to document anything yourself. The researcher will do all documentation when tracking your injury from day to day. You will not be asked to do anything unnecessary to help with this study. This study will encompass the 1998-1999 hockey season. Data will be collected from the first official day of practice through the last day of the regular season. Playoff time will not be documented.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. Names of athletes will not appear in the written results of this study. The only person that will know the names of the participants is the researcher. Data will not include names, only injuries, injury rates, and time away from participation. Individual case studies will not be a part of the study and/or the final results.

If you decide to participate, and are less that 18 years of age at the start of your collegiate hockey season, both parents and/or guardian(s) must sign the consent form.

Your decision whether or not to participate will not prejudice your future relations with I (Rachel Johnson), the researcher. If you decide to participate,

you are free to discontinue participation at any time without prejudice. If you have any questions please ask me. If you have any additional questions later I will be happy to answer them. You may contact me, Rachel Johnson ATC/R, at (w) 255-2597 or 654-5229, and (h) 203-8017.

Your signature indicates that you have read the information provided above and have decided to participate. By signing this consent form and choosing to participate, you are giving the researcher (Rachel Johnson) access to your 1998-99 hockey related injury reports. This medical information will always remain confidential, and only the researcher will have access to the medical information. You may withdraw at any time, without prejudice after signing this form, should you choose to discontinue participation in this study.

Signature	Print Name	Date

Signature of parents or guardians **(only if under 18)**	Date

APPENDIX D

Chi-Squared Raw Data

Identifiable Ways that Injuries Occurred

	Count Expected Value	Collision	Other Object	Non Collision	Row Total
Women	1	43 (.67 inj/player)	15 (.23 inj/pl)	22 (.34 inj/pl)	80 59.3%
Men	2	31 (1.47 inj/pl)	7 (.33 inj/pl)	17 (.81 inj/pl)	55 40.7%
	Column Total	74 54.8%	22 16.3%	39 28.9%	135 100%

Neither gender was more likely to suffer injuries in any one way when compared to the other gender:

X^2 (2) = 4.63, P > .050

Injury Types by Gender

	Count Expected Value	Soft Tissue	Head/Neck	Bone/Joint	Row Total
SCSU Women	1	7	9	15	31 23%
SCSU Men	2	29	7	19	55 40.7%
UNH	1	5	4	7	16 11.9%
U of MN	1	18	1	14	33 24.4%
	Column Total	59 43.7%	21 15.5%	55 40.8%	135 100%

Results are significant for ALL females suffering more bone and joint injuries when compared to male Division I ice hockey player.

Bone/Joint:

X^2 (2) = 5.24, P > .05

Time Lost From Hockey Due to Injury

	Count Expected Value	0 Days Lost	1-6 Days Lost	7-14 Days Lost	Row Total
Women	1	42	27	6	75 61.5%
Men	2	24	16	7	47 38.5%
	Column Total	66 54.1%	43 35.2%	13 10.7%	122 100%

Results are significant for the men to more likely miss activity due to injury:

0-6 days: $X^2 (2) = 4.9, P < .05$

7-14 Days: $X^2 (1) = .384, P > .50$

Injury Rates by Gender and Position

	Count Expected Value	Forwards (offense)	Defense	Goalies	Row Total
Women	1	18 (.31 inj/pl)	16 (.62 inj/pl)	7 (.27 inj/pl)	31 36.0%
Men	2	28 (1.27 inj/pl)	23 (1.05 inj/pl)	4 (.18 inj/pl)	55 64%
	Column Total	36 41.9%	39 45.3%	11 12.8%	86 100%

Forwards are significantly more likely to suffer an injury compare to other positions in Division I ice hockey.

Forwards (Significant): $X^2 (2) = 11.1, P > .50$

Goalies (not significant): $X^2 (2) = .818, P > .50$