©Journal of Sports Science and Medicine (2005) **4,** 58-65
http://www.jssm.org

Research article

RECREATIONAL ICE HOCKEY INJURIES IN ADULT NON-CHECKING LEAGUES: A UNITED STATES PERSPECTIVE

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Received: 20 December 2004 / Accepted: 08 February 2005 / Published (online): 01 March 2005

ABSTRACT

The purpose of this study was to analyze injuries among adult recreational ice hockey players. This was an observational prospective cohort study with data collected on injuries sustained during one season in the adult recreational ice hockey leagues of Oneida County, NY. The injury incidence rate was found to be 12.2/1000 player-exposures. The most common anatomic region injured was the head/neck/face (35%). Collisions were most often reported as the mechanism of injury (44%). Fracture was the most common diagnosis. Of players wearing face protection (full cage or shield, or partial visor/half shield), none suffered facial injuries, while all facial injuries reported were to players not wearing facial protection. The concussion rate was 1.1/1000 player-exposures. A lack of protective equipment was associated with 38% of injuries and 24% of injuries involved penalties. A history of prior injuries was found in 89% of injured players with 28% re-injuring the same body part. This study's findings suggested various strategies to address player injuries such as mandatory full facial protection and shoulder pads, strict enforcement of game rules, and game rule modifications (no body checking). Further research is needed on the role of preventive rehabilitation in players with previous injury history.

KEY WORDS: Ice hockey, recreational, adult, old-timer, United States.

INTRODUCTION

With the increasing popularity of professional ice hockey across the United States (US) in recent years, there has also been an increase in the number of adult recreational ice hockey players. The popularity of adult recreational ice hockey was evident in Oneida County, NY as seen by the growing number of participants in the leagues in operation. Local league play consisted of a total of 23 teams in 4 separate leagues and approximately 300 players.

The only study investigating the epidemiology of injuries in adult recreational ice hockey has been done in Canada (Voaklander et al., 1996b). No such studies have been conducted in the US to date. Furthermore, no studies that we're aware of have investigated ice hockey under the conditions distinctive to the adult leagues in Oneida County regarding required hockey equipment and altered game rules.

The Canadian literature on adult recreational ice hockey has reported a high incidence of facial injuries and injuries in part related to lack of, or misuse of equipment (Deady et al.,1996; Voaklander et al., 1996a). Puck related lower extremity injuries were also reported as frequently occurring injuries (Voaklander et el., 1996b). The purpose of this study was to analyze the incidence and nature of injuries among US adult recreational ice hockey players.

Another important issue in adult recreational ice hockey is re-injury. Many recreational players come from a competitive hockey background and report injuries sustained during previous experience. Hence, it can be hypothesized that previous injuries are a risk factor for sustaining similar or related injuries.

Given the aim of this study to analyze the nature and incidence of injury among adult recreational ice hockey players in Oneida County, NY, it was hoped that the outcomes of this study

contribute to ideas for the development of injury prevention strategies to improve safety in adult recreational ice hockey. This study population, also known as "old-timer" ice hockey players, make up a distinct ice hockey study population (with regards to use of protective equipment or altered game rules) and has not received as much study as the professional, collegiate, youth or other ice hockey players.

METHODS

Approval for this study was obtained by the IRB/ethics committee of the St Elizabeth Medical Center in Utica, NY. Subjects were recruited from the four adult recreational ice hockey leagues in Oneida County, NY, including the Clinton, New Hartford, Rome and Whitestown leagues. All leagues had credentialed referees and all subjects signed the study informed consent form. Permission to obtain injury data was obtained from the league administrators prior to the start of the study. The players were at least 18 years or older and all were male. The age range was from 18 to 55 years of age with 45 players less than 30 years of age and 152 players 30 years or older (of which 44 were 40 years or older). The participants were former players at the high school, college and minor professional league levels. The games were played under modified ice hockey rules that prohibited and penalized (minor penalty) body checking and slap shots. Also, wearing face shields (except for goaltenders) and protective body pads (such as shoulder pads) were not compulsory.

Players were recruited for the study in the dressing room prior to the start of the first games for the 2001-2002 ice hockey season by the authors. Enrollment and consent forms were completed as subjects were recruited and injury forms were used to record injuries. Student physical therapists attended all games and recorded player participation and injury data on the injury forms. They were instructed and trained in data collection prior to the beginning of the study. There were only games and no practices for all the leagues. Additional data from medical records for each injury sustained (including diagnosis and treatment) were obtained from the treating medical facilities. Participants agreed to the release of this information on the informed consent/medical release form.

For the purposes of this study an injury was defined as an activity related medical condition arising from ice hockey participation that prevented a player from completing a game, caused a player to miss a game, required a player to seek medical or dental care, or was a concussion. The Vienna 2001 consensus statement definition (Aubry et al., 2002) was used to describe concussions when this diagnosis was encountered during data collection.

A pilot study (data not included in this study) was conducted from January 5th through February 11th 2001, which served to develop and test the injury forms as well as plan the logistics of the study. The formal study period took place from September through March during the 2001-2002 ice hockey season. Incidence rates were calculated per player-exposure (defined as a game attendance). Game attendance refers to actual participation in play during a game by players without recording total ice time per player. The incidence rate was calculated using the equation: rate = total number of injuries/ sum of reported game attendance for all players. Injury data were collected to compare facial injuries in players with and without facial protection. Overall, the anatomic, diagnostic and mechanistic distributions of injuries were analyzed. A total of 196 players enrolled in the study from a pool of approximately 300 players participating in the leagues. All players were followed by the study investigators to completion of the study. Of the medically treated injuries, only one did not have verifiable documentation to support the diagnosis. The player was able to recollect with sufficient detail his rib fracture as diagnosed by his medical practitioner. Data were compiled using the Statistical Package for Social Sciences (SPSS).

RESULTS

A total of 34 injuries to 28 players were reported during the 2001-2002 ice hockey season for the Oneida County adult recreational ice hockey leagues. The total cumulative injury index was found to be 17.3% (total number of injuries/ total population or 34/196). The total injury incidence rate was found to be 12.2/1000 player-exposures (total number of injuries/total player-exposures per 1000 or 34/2784).

The average age for injured players was 33.5 years. The percentage of injured players less than 30 years of age was 25% (7) and those 30 and over was 75% (21). These numbers were similar for non-injured players where the average age was 34.2 years and players less than 30 made up 22% (37) and those 30 and over 76% (128) with 2% (3) not reporting their age. With respect to previous competitive experience (varsity high school, college and professional level) for injured players, 64% (18) played competitive hockey and 36% (10) did not. As for non-injured players, 67% (113) played competitive hockey and 18% (31) did not with 14% (24) not responding to the question.

The overall anatomic distribution, diagnostic frequencies and mechanism of injury are listed in

Table 1. Overall injury distribution.

Anatomic Region	Frequency	Percentage
Head/Neck/Face	*12*	*35*
Upper Extremities	7	21
Torso	7	21
Lower Extremities	8	24
Total	34	101
Diagnosis		
Fracture	*10*	*29*
Sprain/Strain	9	26
Laceration	5	15
Contusion	4	12
Concussion	*3*	*9*
Low Back Pain	2	6
Dislocation	1	3
Total	34	100
Mechanism		
Collisions	*15*	*44*
Puck Contact	6	18
Stick Contact	5	15
Routine Play	4	12
Falls	3	9
Fighting	1	3
Total	34	101

Total percentage does not always equal 100 because of rounding

Table 2. Head/Neck/Face.

Anatomic Region	Frequency	Percentage
Head	3	25
Lip	3	25
Nose	2	17
Teeth	2	17
Cheek	1	8
Eye	1	8
Total	12	100
Diagnosis		
Laceration	*5*	*42*
Concussion	3	25
Tooth Fracture	2	17
Nose Fracture	1	8
Nose Contusion/Bleed	1	8
Total	12	100
Mechanism		
Collisions	3	25
- With Boards	(2)	(17)
- With Ice	(1)	(8)
Stick Contact	3	25
- Legal	(2)	(17)
- Illegal	(1)	(8)
Puck Contact	*6*	*50*
Total	12	100

Table 1. The most frequent anatomic region injured was the head/neck/face 35% (12). Overall, the most frequent diagnosis was fracture 29% (10) and the predominant mechanism of injury was collisions 44% (15) (of which 60% (9) occurred with the boards, 20% (3) with players and 20% (3) with the ice).

The head/neck/face injury data are summarized in Table 2. The most common diagnosis for the head/neck/face injuries was laceration 42% (5) and the predominant mechanism of injury was puck contact 50% (6). Of the 196 players in the study, 57% (111) wore facial protection and 43% (85) did not. Facial protection use was determined for each player at the beginning of the season and after their injury occurred. All facial injuries were to players not wearing facial protection. Players wearing full facial protection (full cage or shield) and partial facial protection (visor or half shield) suffered no facial injuries. The concussion rate was calculated to be 1.1/1000 player-exposures. Two concussions were due to collisions with the boards and one with a player, which ultimately resulted in a collision with the ice (none were due to penalties). Loss of consciousness occurred for two concussions. There was one rule infraction involving illegal stick contact that resulted in a facial laceration.

Upper extremity injury analysis revealed the most frequent anatomic region injured to be the shoulder 57% (4). The most frequent upper extremity diagnosis was sprain/strain 43% (3) and the predominant mechanism of injury was collisions 86% (6). Two of the collisions were with the ice and both a result of illegal activity (Table 3). Three of the upper extremity injuries (43%) were associated with penalties (2 body checks and 1 illegal stick contact). Of the players who suffered shoulder injuries, 50% were not wearing shoulder pads and both injuries occurred as a result of unintentional collisions with the boards.

Table 3. Upper extremity.

Anatomic Region	Frequency	Percentage
Shoulder	*4*	*57*
Elbow	1	14
Hands	2	29
Total	7	100
Diagnosis		
Sprain/Strain	*3*	*43*
Fracture	2	29
Dislocation	1	14
Contusion	1	14
Total	7	100
Mechanism		
Collisions	*6*	*86*
- With Boards	(4)	(57)
- With Ice	(2)	(29)
Stick Contact (Illegal)	1	14
Total	7	100

Table 4. Torso.

Anatomic Region	Frequency	Percentage
Ribs	*5*	*71*
Lumbar Spine	2	29
Total	7	100
Diagnosis		
Fracture	*3*	*43*
Contusion	2	29
Spondylolysis	1	14
Low Back Pain	1	14
Total	7	100
Mechanism		
Collisions	*4*	*57*
- With Boards	(2)	(29)
- With Players	(2)	(29)
Stick Contact (Illegal)	1	14
Fighting	1	14
Routine Play	1	14
Total	7	99

Total percentage does not always equal 100 because of rounding

The most frequent anatomic distribution for torso injuries consisted of the rib cage 71% (5). The most frequent diagnosis was rib fracture 43% (3) and the predominant mechanism of injury was collisions 57% (4) (Table 4). Penalties were associated with 57% (4) of the torso injuries. The penalties included 1 illegal stick usage, 1 collision with the boards (body check from behind), 1 collision with the player (body check), and 1 fighting. Of the rib cage injured players, 40% (2/5) were not wearing any shoulder pads and 80% (4) of rib injuries were a result of illegal activity.

Table 5. Lower extremity.

Anatomic Region	Frequency	Percentage
Ankle	*3*	*38*
Groin	2	25
Hamstring	2	25
Knee	1	12
Total	8	100
Diagnosis		
Sprain/Strain	*6*	*75*
Fracture	2	25
Total	8	100
Mechanism		
Collisions	2	25
- With Boards	(1)	(12)
- With Players	(1)	(12)
Falls	3	37
Routine Play	3	37
Total	8	101

Total percentage does not always equal 100 because of rounding

Lower extremity injuries revealed the ankle as the most frequent anatomic region injured 38% (3). The most frequent diagnosis was sprain/strain 75% (6) with no predominant mechanism (Table 5). No lower extremity injuries were due to penalties.

Severity of injury (Table 6) was classified as mild (resulting in < 8 days of absence from hockey play), moderate (resulting in 8 – 28 days of absence from hockey play), and severe (resulting in > 28 days of absence from hockey play). Of the most debilitating injuries (classified as severe), 71% (5) consisted of soft tissue injuries (2 hamstring strains, 1 groin strain, 1 traumatic rotator cuff tendonitis and 1 back pain due to muscle spasms). The remaining 29% (2) consisted of fractures (1 bimalleolar ankle fracture and 1 distal fibular fracture). Moderate injuries consisted of rib fractures 43% (3), sprains 28% (2) (1 ankle and 1 acromioclavicular), facial laceration 14% (1) and concussion 14% (1).

Table 6. Severity of Injury.

Severity of Injury (days absent from hockey play)	Frequency	Percentage
Mild (< 8)	20	59
Moderate (8-28)	7	21
Severe (>28)	7	21
Total	34	101

Total percentage does not equal 100 because of rounding

Analysis of acute vs. chronic injury revealed that 88% (30) of the injuries were acute and 12% (4) were chronic. Of the chronic injuries 75% (3) were overuse injuries (1 hamstring strain, 1 spondylolysis, and 1 low back pain), the other one was a recurrent shoulder dislocation. The mechanism for chronic injuries included: routine play (2) and collisions (2) (both unintended, 1 with a player and 1 with the boards). Most of the overuse injuries (2) occurred during routine play.

The medical facility where initial treatment was sought was summarized in Table 7. Hospitalization occurred in 1 case of a bimalleolar ankle fracture (4 days).

Table 7. Facility of initial treatment.

Facility of Initial Treatment	Frequency	Percentage
Doctor's Office	12	35
Hospital Emergency Department	10	29
No Facility or Self Treat	12	35
Total	34	99

Total percentage does not equal 100 because of rounding

Previous injuries were reported in 89% (25) of the injured players, while 11% (3) never had previous injuries. This was substantially different from the non-injured players where 51% (86) had previous injuries and 48% (81) never sustained an injury with 0.6% (1) not responding to the question. Furthermore, 28% (8) of the injured players previously sustained an injury to the same body part injured during the current study.

Analysis of injured players with respect to position played revealed that 57% (16) were forwards, 36% (10) were defensemen and 7% (2) were goaltenders. This distribution was similar for non-injured players where forwards made up 64% (107), defensemen 32% (54) and goaltenders 10% (17) with 1% (2) not reporting their positions. Non-injured data does not add up to 100% because some players equally played several positions.

Distribution of injuries according to period of play revealed that 32% (11) occurred during the first period, 21% (7) during the second period, 44% (15) during the third period and 3% (1) during the pregame warm-up.

Penalties were assessed in 24% (8) of the injuries according to the following distribution: 12% (1) for head/neck/face, 38% (3) for upper extremity, 50% (4) for torso and 0% (0) for lower extremity injuries. Furthermore, 50% of injuries due to penalties (12% of total injuries) involved body checking.

DISCUSSION

The injury rate of 12.2/1000 player-exposures in this study was consistent with similar work done in Canada (Voaklander et al., 1996b). In our study, the use of direct observation with onsite and trained personnel (student physical therapists) in addition to telephone interviews and verification of medical records, decreased the self-reporting bias for anatomic, diagnostic and mechanistic frequencies and distribution. Also, by maintaining direct participation records, the self-reporting bias for the player-exposure (denominator) was minimized. Comparison with similar literature (Voaklander et al., 1996b) was facilitated by using similar injury definition and denominator (per 1000 player-exposures) in reporting injury rates.

The anatomic distribution of injuries in this study showed a higher frequency of head/neck/face injuries (35% compared to 25%) and torso injuries (21% compared to 10%) but a lower frequency of lower extremity injuries (24% compared to 40%) to similar Canadian literature (Voaklander et al., 1996b). The old-timer league in the Canadian study had the same game rule modifications (no slap shot and no body checking), and the same rule not requiring facial protection (except for goaltenders) as our study. The main difference was that shoulder pads were required for the Canadian study but not for the leagues in our study. The higher frequency of head/neck/face and torso injuries may be explained by the combination of lack of protective equipment (all facial injuries occurred to the unprotected face) and penalties (80% of the rib cage injuries).

The diagnostic distribution revealed similar trends to the Canadian literature (Voaklander et al., 1996b), with the exception of fracture, which was the most common diagnosis (29%) in this study compared to 9%. In this study dental fractures were included in the fracture diagnosis contributing to the overall fracture frequency. The concussion rate of 1.1/1000 player-exposures falls within the wide range reported for university and elite amateur teams (Honey, 1998). Concussion rates for adult recreational leagues are lacking in the literature. Other common diagnoses such as sprains/strains, lacerations, and contusions showed similar trends to past literature (Daly et al.,1990; Deady et al.,1996). Lacerations were previously found to occur mainly to the unprotected face (Deady et al., 1996) and was supported in this study given that 100% of the lacerations reported were to the unprotected face area.

Collisions, comprised the predominant mechanism (44%) and most were due to either unintended collisions with boards/players or intended collisions (body checks). In fact, 50% of injuries due to penalties involved body checking. Hence, body checking in a non-checking league is associated with increased incidence of injury. This supports the no body check game rule modification in old-timer recreational ice hockey leagues, which needs to be enforced.

Penalties were associated with 24% of all injuries, similar to previous research (Voaklander et al., 1996b). This supports strict enforcement of game rules. Perhaps, the awarding of bonus league points for fair play to the team with fewer penalties regardless of game outcome, may help reduce injuries as suggested previously (Marcotte and Simard, 1993; Voaklander et al., 1996b; Roberts et al., 1996). This needs further research in adult recreational ice hockey.

Lack of protective equipment was found in 38% of injuries. All facial injuries involved lack of facial protection. Also, 50% of the players who sustained shoulder injuries were not wearing shoulder pads and 40% of players who suffered rib injuries had no shoulder pads. In this case, the shoulder pads could have possibly prevented these injuries as most involved unintended collisions with the boards.

Most injuries (44%) occurred during the third period of play. This is consistent with other research (Lorentzon et al., 1988; Daly et al., 1990; Stuart and Smith, 1995; Voaklander et al., 1996b; Molsa et al., 1997; Pinto et al., 1999) and may be due to lack of conditioning in once a week players with no practices or conditioning. Of the injuries arising from penalties, 88% (7/8) occurred during the third period. Perhaps this is due to more aggressive behavior and/or fatigue during the third period when game outcomes are decided.

Most of the injuries classified as severe in this study, consisted of potentially preventable recurrent soft tissue injuries (groin and hamstring strains, and low back spasms). This suggests that targeted injury prevention exercise programs prior to the start of the hockey season may be warranted to reduce the chance for sustaining these debilitating injuries. This requires further study with a larger sample size to be able to determine the effect of such programs. Only one injury in this study required player hospitalization, and this finding is consistent with other research (Voaklander et al., 1994; 1996b).

Comparison of acute versus chronic injuries was similar to other research (Daly et al., 1990; Voaklander et al., 1996b). The majority of injuries in this study were acute 88%. The chronic injuries made up 12% of the total and were mainly due to overuse mechanisms.

The history of previous injury was found to be an important factor in the injuries sustained in this study. It was found that 89% of the injured players had sustained previous injuries and that 28% of them re-injured the same body part. These data support the use of a preseason screening procedure to identify players previously injured.

The medical facilities where initial treatment was sought revealed similar trends to the Canadian experience (Voaklander et al., 1996b). Most injured players sought treatment at a doctor's office with a second group seeking initial care in an emergency room. The difference in this study was that a greater percentage of players opted not to seek treatment or to self treat (35% versus 20%). One reason for this difference may relate to medical coverage. The Canadian players have access to universal healthcare whereas their American counterparts do not, and some players need to rely on out of pocket payment plans. In fact, it was reported that some players did not have any medical coverage and asked about treatment options.

There were no injury patterns or trends with respect to player age, position played or previous competitive experience when comparing injured and non-injured players.

A limitation of this study is the relatively small sample size (196 subjects) with a 65% study participation rate. Another limitation is the possibility of players underreporting chronic overuse injuries. The lack of coordinated onsite medical services such as training room facilities with an athletic trainer or team physician may contribute to the underreporting of such injuries. Another possibility for underreporting may be that the "hockey culture" mentality - where rough aggressive play and not reporting injuries are traits valued by the players.

CONCLUSIONS

The aim of this study was to analyze the nature and incidence of injury among adult recreational ice hockey players from a US perspective in Oneida County, NY. The outcomes of this study have allowed us to participate in the development of injury prevention strategies that have the potential to lead to improved safety in adult recreational ice hockey. The injury rate observed was consistent with similar previous research in Canada (Voaklander et al., 1996b).

This study demonstrated that facial injuries are still common in adult recreational ice hockey where full facial protection is not required. Our data also suggested that a higher occurrence of injury was associated with failure to wear shoulder pads, but further studies are needed to demonstrate cause and effect. Penalty-related activity was also associated with a higher injury occurrence. Given these findings, it can be concluded that not wearing full facial protection and shoulder pads can present risk factors for injury and that penalty-related activities increase the likelihood of players sustaining injuries.

A concussion rate of 1.1/1000 player exposures poses a real injury risk. It was not clear from this study how to reduce or eliminate this, and further research on this subject is needed for this type of population.

The high percentage of injured players with previous injury history, and the potentially preventable chronic overuse soft tissue injuries causing lengthy time loss from participation, raised the question of what role a targeted preseason rehabilitation program could play with these players. The answer to this question requires further research.

Several suggestions can be made from this study regarding injury prevention strategies for the adult recreational ice hockey population.

- Full facial protection should be compulsory for all players.
- There should be strict enforcement of game rules (such as no body checking) with harsher penalties for rule infractions.

- Game rule modifications eliminating body checks in reducing injuries was supported in this study.
- Shoulder pads should be compulsory for all players.
- Primary care and emergency physicians are the frontline medical providers for adult recreational ice hockey injuries and should have an understanding of how to manage common ice hockey injuries including concussions.

The above conclusions can potentially further reduce injuries and make adult recreational ice hockey a safer and more enjoyable sport.

ACKNOWLEDGEMENTS

This research study was funded by the St Elizabeth Medical Center (SEMC) trauma department in Utica, NY. Many thanks to the SEMC trauma surgeons who made this research possible by donating their fees for trauma call. We would like to thank the Oneida County adult recreational ice hockey league administrators and players for their participation. We would also like to thank the Utica College physical therapy students (Brian Kelley, Gabe Mattson, and Eric Stewart) for their involvement. Finally, we would like to thank Mr Ralph Requa and Dr James Garrick for their review of this manuscript and for providing useful suggestions.

REFERENCES

Aubry, M., Cantu, R., Dvorak, J., Graf-Baummann, T., Johnston, K., Kelly, J., Lovell, M., McCrory, P., Meeuwisse, W. and Scharmasch, P. (2002) Summary of the first international conference on concussion in sport, Vienna Austria. *Clinical Journal of Sport Medicine* **12,** 6-11.

Benson, B.W., Mohtadi, N.G., Rose, M.S., and Meeuwisse, W.H. (1999) Head and neck injuries among ice hockey players wearing full face shields vs half face shields. *JAMA* **282,** 2328-2332.

Castaldi, C.R. (1991) Prevention of craniofacial injuries in ice hockey. *Dental Clinics of North America*. **35,** 647-656.

Daly, P.J., Sim, F.H. and Simonet, W.T. (1990) Ice hockey injuries. A review. *Sports Medicine* **10,** 122-131.

Deady, B., Brisson, R.J. and Chevrier L. (1996) Head, face and neck injuries in hockey: A descriptive analysis. *Journal of Emergency Medicine* **14,** 645-649.

Honey, C.R. (1998) Brain injury in ice hockey. *Clinical Journal of Sport Medicine* **8,** 43-46.

LaPrade, R.F., Burnett, Q.M., Zarzour, R. and Moss, R. (1995) The effect of the mandatory use of face masks on facial lacerations and head and neck injuries in ice hockey. *American Journal of Sports Medicine* **23,** 773-775.

Lorentzon, R., Wedren, H., Pietila, T. and Gustavsson B. (1988) Injuries in international ice hockey: A prospective, comparative study of injury incidence and injury types in international and Swedish elite ice hockey. *American Journal of Sports Medicine*. **16,** 389-391.

Marcotte, G. and Simard, D. (1993) Fair-play: An approach to hockey for the 1990s. In: *Safety in ice hockey: Volume 2*. Eds: Castaldi C.R., Bishop, P.J. and Hoemer, E.F. Philadelphia: ASTM. 100-108.

Molsa, J., Airaksinen, O., Nasman, O. and Torstila, I. (1997) Ice hockey injuries in Finland: A prospective epidemiologic study. *American Journal of Sports Medicine* **25,** 495-499.

Pashby, T.J. (1985) Eye injuries in Canadian amateur hockey. *Canadian Journal of Opthalmology* **20,** 2-4.

Pinto, M., Kuhn, J.E., Greenfield, M.L. and Hawkins, R.J. (1999) Prospective analysis of ice hockey injuries at the Junior A level over the course of one season. *Clinical Journal of Sport Medicine* **9,** 70-74.

Rampton, J., Leach, T., Therrien, S.A., Bota, G.W., and Rowe, B.H. (1997) Head, neck and facial injuries in ice hockey: The effect of protective equipment. *Clinical Journal of Sport Medicine* **7,** 162-167.

Roberts, W.O., Brust, J.D., Leonard, B.J. and Hebert, B.J. (1996) Fair play rules and injury reduction in ice hockey. *Archives of Pediatrics & Adolescent Medicine* **150,** 140 –145.

Smith, A.M., Stuart, M.J., Wiese-Bjornstal, D.M. and Gunnon, C. (1997) Predictors of injury in ice hockey players. A multivariate, multidisciplinary approach. *American Journal of Sports Medicine*. **25,** 500-507.

Stuart, M.J. and Smith, A. (1995) Injuries in Junior A ice hockey: A three-year prospective study. *American Journal of Sports Medicine* **23,** 458-461.

Voaklander, D.C., Brison, R.J., Quinney, H.A., Mcnab, R.B. and Darko, E. (1994) Ice hockey injuries treated in two emergency departments. *Clinical Journal of Sport Medicine* **4,** 25-30.

Voaklander, D.C., Saunders, L.D. and Quinney, H.A. (1996a) Correlates of facial protection use by adult recreational ice hockey players. *Canadian Journal of Public Health.* **87,** 381-382.

Voaklander, D.C., Saunders, L.D., Quinney, H.A. and Mcnab R.B. (1996b) Epidemiology of recreational and old-timer ice hockey injuries. *Clinical Journal of Sport Medicine* **6,** 15-21.

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KEY POINTS

- The injury incidence rate was found to be 12.2/1000 player-exposures, similar to previous Canadian literature.
- The concussion rate was 1.1/1000 player-exposures.
- 38% of injuries involved a lack of protective equipment and 24% of injuries involved penalties.
- Full facial protection and shoulder pads should be compulsory.
- Strict enforcement of game rules is necessary.
- History of prior injuries was found in 89% of injured players.

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