Observational Analysis of Injury in Youth Ice Hockey:

Putting Injury into Context

by

CHARLES BOYER

Bsc. H.K., University of Ottawa, 2008

THESIS

Submitted to the Faculty of Graduate and Postdoctoral Studies for the degree of

Master's of Arts in Human Kinetics

School of Human Kinetics

University of Ottawa

2011

ABSTRACT

This study examines injury in competitive bodychecking and non-bodychecking youth ice hockey in male and female leagues in Ontario and Quebec. The study involved quantifying the amount of injuries, but also documenting the situational factors in which hockey injuries occur to better understand how and why injuries are occurring. The research utilized a mixed method approach consisting of game observation, postgame injury assessments and semi-structured interviewing with parents. In total 56 games were attended and a total of 16 parents from the bodychecking team were interviewed. All games were video recorded through a dual camera video system. Game footage was then analyzed frame-by-frame to pinpoint injury locations, points of impact and situational factors surrounding the injury. Results from the research revealed; 1) a disproportionately higher rate of injury in bodychecking hockey compared to non-bodychecking male and female hockey; 2) the combination of player and board contact in bodychecking hockey is the primary mechanism of injury; 3) most injuries occur on legal play; and 4) parental perceptions of bodychecking and injury show that players do not naturally accept bodychecking as part of the game.

TABLE OF CONTENTS

LIST OF FIGURES

ACKNOWLEDGMENTS

I would first like to thank the three partnering hockey associations for their participation in this study: Ottawa District Minor Hockey Association, Ottawa Girls Hockey Association and L'Association de Hockey Minor de Hull. Without these partnerships this research would not have been possible. For such an intensive injury reporting scheme to function, I needed the help of over 20 volunteers who all made a significant contributions to the project. A special thanks goes to Dr. Brad Young and Dr. Alex Dumas for being committee members and for the significant influence on shaping and modifying the study. Lastly, a huge thank you must be given to Dr. Michael Robidoux who invested so much of his time and effort into my thesis. Without his guidance this thesis would never have been completed. Thank you.

CHAPTER I: Introduction

Safety in hockey has become a salient topic in both public and scholarly discourse. Recent events have brought further scrutiny to the issues contributing to injury. In the 2009/2010 hockey season, sixteen year old Ben Fanelli made headlines across the nation after suffering skull and facial fractures after receiving a bodycheck in an Ontario Hockey League (OHL) game. The OHL commissioner was cited afterwards saying: "send out the message to all our players and minor hockey players that we have to be respectful, more respectful, of our opponent" (Branch, 2009). Also in 2009, twenty year old Don Sanderson passed away as a result of his head colliding to the ice during a fight in an Ontario Hockey Association game. Steve Cardwell, president of the team for which Sanderson played, said in response to the event:

> Any time a tragedy like this happens—and it could have been prevented by a number of rule changes, or the way helmets are made, or the way that they work—that debate needs to happen, because if you lose just one life and you don't learn from it, then we're all making a big mistake (Cardwell, 2009)

To add to this public debate, the National Hockey League (NHL) has held lengthy General Managers meetings to address the issue of high velocity bodychecks that impact the head (Dreger, 2009). The recent public scrutiny of injury in hockey is forcing amateur and professional associations/leagues to reevaluate rules to mitigate the risk of injury. This is an opportune time for researchers to contribute to this discussion, to shed light on the factors contributing to injury so they might be reduced.

Although injury is now at the forefront of the hockey world, researchers have made great contributions to the knowledge of injury in hockey for the past 40 years. Such scientific

study has accurately measured the frequencies and characteristics of injury through sophisticated medical based injury reporting. Such medical reports however have been unable to provide contextual information surrounding injury. With hockey being such a fast paced game, the ability to recall exactly how an injury occurred is nearly impossible. A turn to qualitative injury reporting was necessary in order to capture the exact causes of injury. Sociologists have accurately measured the social influences that create an environment for the acceptance of pain and injury. Such studies of injury were useful, not only to assist in understanding how injury is perceived in minor hockey, but to shed light on the general tolerance of pain and injury in the sport. Truly lacking, however, was a descriptive qualitative analysis of how individual injuries occurred in youth hockey.

Designing a study to comprehensively examine situational factors surrounding injury in youth hockey was not an easy task. Attempting to understand how and why 11-12 year old hockey players were getting hurt initially proved disconcerting for some parents. Although our intentions were to create a safer environment for youth, the idea that we were there to document their children getting hurt was not easy to accept as it fore grounded the potential risk players face when playing hockey. Further, within a performance based sport ethic, it is well known that coaches can endorse an injurious environment for the sake of winning (Johns, 2004; Sabo 2004; Vaz, 1982; Weinstein, Smith, & Wiesanthal, 1995). As such, one coach did not appreciate being studied by an outside research group focusing on injury. In the beginning, the tension between researchers and the community was evident. However, through a community based research approach, that involved all parties in research designs, that provided research updates and game footage throughout the year, extremely positive relationships were formed. By the conclusion of this study, researchers and

stakeholders worked in tandem in an attempt to understand how and why injuries occur in youth hockey.

To comprehensively examine youth hockey injury, this study moved beyond any other type of injury reporting, combining both quantitative and qualitative methods. From the outset it was deemed imperative to include team trainers and medical personnel as part of documenting injury. Trainer's had both full access to the athletes and the medical knowledge required to accurately assess and document the injuries in detail. In addition to this systematic injury reporting, researchers observed all on ice play allowing for injuries to be documented without the player verbally acknowledging that he or she was hurt. Such involuntary reporting was necessary as hockey is celebrated for its tolerance and internalizing of pain and injury (Charlesworth & Young, 2004; Donnelly, 2004; Juhn, Brolinson, Duffey, Stockard, Vangelos, Emaus et al., 2002; Yard & Comstock, 2006; Young, McTeer, & White, 1994). The injuries observed by researchers were further validated through the use of video replay, as all games were videotaped and were able to be reviewed to accurately assess the contributing factors of injury. To aid in capturing more subtle details surrounding the experiences with injury, interviews were conducted with all parents and coaches of participating players in the study. Such interviews explained exactly what youth experienced with injury, offering unexpected insights about how youth deal with physical play.

Hence, from the novel methodology reporting system offered, this research had two primary objectives: (1) provide comparative data about injury in male bodychecking leagues vesus male non bodychecking hockey and female non-bodychecking hockey; and 2) document situational factors contributing to injury to understand how and why youth are

getting injured playing competitive hockey. Through this study it was determined that bodychecking hockey had significantly more injuries than boys and girls non-bodychecking hockey. In fact with so few injuries occurring in boys and girls non-bodychecking hockey, much of the focus of this thesis is on Ontario boys bodychecking hockey.

CHAPTER II: Literature Review

The concern around injury in youth sport can be seen in the growing body of literature studying the issue. Researchers from a variety of academic disciplines have utilized quantitative and qualitative methods to better document the amount and types of injuries youth experience. The majority of this research however has been quantitative and has focused primarily on injury frequency. Larger epidemiological studies have increased our awareness of hockey injuries, documenting high rates of injuries at all levels. Qualitative studies focusing on the environment of injury are also making important contributions to our understanding of injury. The relatively few, but seminal qualitative studies, have brought to light important information about the cultural constructions of injury in youth hockey, but little attention has been paid to the situational factors in which hockey injuries occur. For example, what is exactly causing young players to be injured? Where on the ice are injuries occurring? Are injuries occurring on legal or illegal plays? What kinds of injuries are young players receiving? Answering these questions and more will benefit the partnering hockey associations and will adhere to Hockey Canada's mission statement which is to "lead, develop, and promote positive hockey experiences" (Hockey Canada, 2010). This literature review will show the benefits and limitations of both approaches towards researching injury.

Defining Injury

In order to conduct studies on injury in sport, one must first begin by understand what is meant by injury and what constitutes an injury in youth sport. From the existing literature, many different scholars and scholarly domains have explored injury in hockey.

Quantitative researchers have had more concrete injury definitions as the one used by the Dick, Agel and Mashall (2007) who define injury as having

> (1) occurred as a result of participation in an organized intercollegiate practice or competition and (2) required medical attention by a team certified athletic trainer or physician and (3) resulted in restriction of the student-athlete's participation or performance for 1 or more calendar days beyond the day of injury (p. 174)

Agel, Dompier, Dick, and Marshall (2007) put such a definition into action and effectively quantified injuries in hockey. Similarly, other quantitative studies enumerated injury by reviewing medical databases and using medical practitioners to diagnose injury (Brown, Mascia, Kinnear, Lacroix, Feldman, & Mulder, 2008; Hostetler, Xiang, & Smith, 2004; Molsa, Kujala, & Myllynen, 2003; Smith, Stuart, Wiese-Bjornstal, & Gunnon, 1997; Tator, Provvidenza, Lapczak, Carson, & Raymond 2004; Yard & Comstock, 2006). However, qualitative research into injury has forced researchers to rethink injury, especially as it relates to the normalizing and acceptance of injuries in the modern sports ethic (Charlesworth & Young, 2004; Donnelly, 2004; Howe, 2001; Johns, 2004; Nixon, 2004; Roderick, Waddington, & Parker, 2000; Sabo, 2004; Young, 2004). Documenting the injury experiences has extended the injury literature but has failed to provide qualitative details explaining exactly how the injury occurred. The documentations of how the sport ethic is adopted and perpetuated is more developed than the actual definition of injury, which is heard here when Malcom (2006) states: "sociological research focusing on the sport ethic and reactions to injuries rarely defines what constitutes an injury" (p. 503).

With quantitative injury reporting focusing on the player reporting injury, there is an obvious limitation since enumeration "is influenced by the motivation of the subject to report

an injury" (Twellaar, Verstappen, & Huson, 1996, p. 529). In order to move beyond voluntary injury reporting, a move toward qualitative injury reporting designs is necessary where researchers define what an injury is, and from this determine if someone is injured or not based on this definition. Dumas and Laforest (2009) have provided one such model by approaching injury as "any accident that stopped the skaters from practicing, whether requiring first aid or not" (p. 23). Others have also approached injury as something more than simply a visit to a medical institution (Fuller, Ekstrand, Junge, Anderson, Bahr, Dvorak, et al., 2006; Tegner & Lorentzon, 1991). By reviewing the literature it is possible to locate the gaps in injury reporting and to show where improvements still need to be made.

Quantifying Injury in Hockey

Frequency of injury

To situate our study and the current knowledge of the frequency of injury in hockey, medical based reporting has been useful. These studies have shown that in youth hockey, between 1990 and 2003 there were "an estimated 172 128 injuries" (Yard & Comstock, 2006, p. 444). That is roughly 1400 injuries per year and these are only injuries that are reported to medical personnel. What is more alarming is that these injuries are occurring more frequently at younger ages. In 2002/2003 emergency departments had "estimates of more than 3000 children 16 years of age and younger with such injuries in Ontario alone" (King & Leblanc, 2006, p. 163). Such large numbers have caused researchers to establish a rate of injury that could be compared to other sports to identify the severity of the issue. This injury rate was defined by Emery and Meeuwsise (2006) who found 30.02 injuries per 100 players based on medical reports.

Establishing a mechanism to measure the frequency of hockey injuries, the rate of injury could be assessed in comparison to other sports. Emery, Meeuwisse and McAllister (2006) surveyed high school athletes about their previous sporting year and found that hockey had the fourth highest injury frequency behind wrestling, gymnastics and football. Hagel and Goulet (2006) similarly found hockey to be an injurious sport and identified it to have the second highest injury rate of all sports played in Quebec. Furthermore, of the following youth sports—soccer, ice hockey, baseball, football, rugby, basketball, handball, netball, volleyball, bandy, bicycle riding, judo and karate—hockey had the most injuries per hourly rate (Spinks & McClure). The devastating outcomes of hockey injuries has intensified as "direct fatality and injury rates for football are half those for hockey" (Marchie & Cusimano, 2003, p. 124). The severity of hockey injuries was further substantiated by Toth, McNeil, and Feasby (2005) who stated that hockey is one of the most common sports for neurological injuries. In accordance with Toth et al's conclusions, Koh, Cassidy, and Watkinson (2003) indicate that hockey and rugby have the highest incidence of concussion of all contact sports. Hockey has also been identified as one of the sports that place's its participants at the greatest risk of spinal injury (Boden & Jarvis, 2009). What is more startling is that at ages 15 years and younger, hockey was found to have the highest hourly injury rate compared to other youth sports (Spinks & Mcclure, 2007).

Types of injury

Quantitative research has been beneficial in reporting injury type and the corresponding anatomical location. Agel et al. (2007) studied collegiate hockey for 16 years and were able to classify injury based on percentages of occurrence: head/neck (15.4%), upper extremity (34.4%), trunk/back (14.3%), lower extremity (34.3%), and other/system

(1.6%). Smith et al. (1997) classified injuries differently by classifying them into two types: musculoskeletal or specific body parts and less specific injuries or characteristics of injury for high school hockey players. The musculoskeletal locations most injured were: knee (14.8%), thigh groin (11.1%), shoulder (11.1%), hip (11.1%), arm/elbow (11.1%), head (11.1%), spine (7.4%), chest/rib (7.4%), fingers (7.4%), chin (3.7%) and wrist (3.7%) (Smith et al.). The most frequent characteristics indentified were: contusions (37%), sprains (22.2%), strains (14.8%), lacerations (11.1%), fractures (7.4%), dislocations (3.7%) and concussions (3.7%).

Mechanisms of injury

To identify causes of injury in hockey, Agel et al. (2007) identified the following mechanisms of injury: contact with another player (47.7%), contact with ice surface (5.9%), contact with boards or glass (21.6%), contact with goal (1.1%) contact with stick (6.4%), contact with puck (7.0%), no apparent contact (9.3%) and other (1.1%). Contact with either a puck or stick during a game can lead to serious injury, as Stuart, Smith, Nieva, & Rock (1995) measured the full speed impact force of a puck to be 1251 lbs and the sticks rotational speed to be 200km/h. Player size is another factor that contributes to injury which has been informed by previous studies (Regnier, Boileau, Marcotte, Desharnais, Larouche, Bernard, et al. 1989; Roy, Bernard, Roy, and Marcotte, 1989; Stuart et al.). Contact with another player can be viewed in a number of different facets and needs to be further broken down. Smith et al. (1997) reported that of the total injuries suffered from bodychecks, 53.1% occurred from receiving a check and 8.2% occurred from delivering a check. In youth hockey, where bodychecking is allowed, Marchie & Cusimano (2003) proved that 83% of injuries result from bodychecking.

Such startling statistics have prompted comparative studies that assess bodychecking and non-bodychecking leagues. Numerous studies comparing bodychecking and non-bodychecking leagues have directly found bodychecking hockey to have higher injury rates than non-bodychecking leagues (Emery, Kang, Shrier, Goulet, Hagel, Benson, et al., 2010; Hagel, Marko, Dryden, Couperthwaite, Sommerfeldt, & Rowe, 2006; Macpherson, Rothman, & Howard, 2006; Regnier et al., 1989). Furthermore, Macpherson et al. analyzed injury rates in Bantam hockey of two different leagues. One league had been playing bodychecking for two previous seasons and the other league was experiencing bodychecking for the first time. The results of the study showed that players with experience playing with bodychecking had higher injury rates than the league experiencing bodychecking for the first time.

To add to the documented injury information surrounding bodychecking and its impact on injury rates, Juhn et al. (2002) noted that of all spinal injuries in hockey, 77% result from contact with the boards. The mechanisms of injury relating to board contact causing devastating injury have been linked to both hitting from behind and boarding (Tator & Edmonds, 1984). Both involve the combination of player and board contact. Although quantitative methods have been able to effectively document injury frequency, mechanisms and characteristics; there are further outcomes and causes associated with injury that still need to be explored. To understand further all aspects that contribute to injury, a turn to qualitative methodologies is needed.

Qualitative Factors Contributing to Injury

The quantitative reporting of injury has come under particular scrutiny as not all injuries get reported to hospitals. Williamson and Goodman (2005) concluded that, "studies based solely on administrative records (such as official injury reports or hospital records) or reports from team staff (such as athletic therapists, physicians, and volunteers) may not account for all concussions" (p. 131). With 20% of hockey players sustaining a concussion during their playing career (Covassin, Swanik, & Sachs, 2003), not all of these devastating injuries will be reported. Also, King and Leblanc (2006) stated that the reporting of injuries in hockey "is likely the tip of the iceberg, since many injuries, particularly concussions, which may have long-term consequences on the developing brain, are underreported" (p. 163). Juhn, et al. (2002) also found that "it is likely that players under-report concussion, as most concussions do not involve loss of consciousness, and players are concerned that they will be removed from practice or games (p. 47)". So, although epidemiological reports are important by showing the high frequency of injuries, studies have shown that the underreporting of injuries causes underestimates, which if accounted for, would make the data from medical reports even more startling.

Studies providing information pertaining to mechanisms of injury and their type and frequency are useful but are relatively limited in scope (Agel, et al., 2007; Yard & Comstock, 2006). Research in this area is based extensively on medical records and other types of secondary data, not on the actual playing behaviours. As a result there is a dearth of observational studies investigating the situational factors contributing to injury in youth hockey. The limited yet seminal studies that have been conducted (Agel et al. 2007; Smith et al., 1997; Stevens, Lassonde, de Beaumont, & Keenan, 2008; Willer, Kroetsh, Darling,

Hutson, and Leddy 2005) highlight critical situational factors that provide insight into injury, e.g.: fatigue, injury ice area locations, intent and non intent to injure, raised aggression levels and the culture of hockey. From this body of literature one takes important steps into understanding injury *in situ* and the complex array of factors contributing to injury.

Fatigue

To analyze in game fatigue of high school hockey players, Smith et al. (1997) timed each athlete on three different teams participating in their study for 3-5 games during the season. To compile data of the amount of time a player spent on the ice, Smith et al. recorded the players name and number as well as the time on the playing clock every time a player came on and off the ice. They found no difference in injury for periods of play or month of the season. Further, they found that two of the three players experienced recurring injuries played 18.9-20.7 minutes a game (roughly 46% of a 45 minute game) and stated that playing time is likely a cause of injury. Similarly, Stevens et al. (2008) measured how much time an NHL player spent on the ice before injury and concluded that the more the player spent on the ice, the greater chance of injury, particularly concussion. To effectively address issues of fatigue, Tyler, Nicholas, Campbell, Donellan, and McHugh (2002) concluded that strengthening the inner thigh muscles or adductor muscles in preparation for a hockey season helps prevent groin strains during a hockey season. Moreover, Wolynski, Brubaker, and Radulovic (1998) have specified strength training anaerobic exercises for the shoulder/neck, knee, spinous erectors, hip, ankle, and the wrist/forearm to reduce hockey injuries. Research focusing on fatigue and injury rates has focused primarily on elite level athletes; how significant fatigue is for youth hockey players has yet to be determined.

Injury ice area locations

While the rules and structure of hockey are relatively uniform, the size of the playing surface varies dramatically from ice surface to ice surface. Studies have shown that the smaller the ice surface the greater chance of injury at the 16-20 age level (Wennberg, 2005; Watson, Murray, & Buckolz, 1997). Agel et al. (2007) took rink size dimensions into consideration in their study and uncovered an increased injury rate for collegiate hockey players playing on smaller ice surfaces compared to those playing on larger ice surfaces. Agel et al. concluded that the high velocity of open ice contact between players is likely to cause injury, and such confrontations are more likely to occur on smaller ice surfaces. Such information is highly valuable and needs to be taken into consideration in order to gain a more comprehensive picture of the scene in which hockey injuries occur. As such, the current injury reporting sheet documented injury locations to see what areas on the ice were more prone to injury in youth hockey.

Physicality, aggression and violence

One of the more controversial and publically debated issues in youth hockey is the role of bodychecking and how/if it contributes to injury. Smith et al. (2007) documented the various types of bodychecking in high school hockey and uncovered two distinctive approaches: one is to injure the opponent through bodychecking; the other is to use bodychecking as a defensive mechanism to separate the opponent from the puck. They argue that coaches, parents and officials must enforce a responsible approach to bodychecking, but do not provide information about bodychecking and overall injury rates. What this data does provide is important information about intent to injure and how player's attitudes might contribute to the risk of injury. In their study on bodychecking, Willer et al.,

(2005) discovered spikes in injury rates at the 8-10 age groups and 12-14 age groups. They hypothesized that the first spike in injury was due to the introduction of bodychecking and the second spike was due to increased testosterone levels and increased size differentials of the athletes.

It is important then to consider physicality in relation to the larger culture of hockey which is typically associated with aggression, intimidation and violent play (Robidoux & Trudel, 2006). Crawford, Stuart, Smith, and Brennan (2004) held focus groups and conducted open-ended interviews with players, coaches and referees to develop a conceptual map of hockey intimidation. They describe how the relational existence between the various actors, their environment and the culture of hockey all contribute to the enduring realities of on-ice intimidation. This study is important in that it recognizes the deeper subjective meanings of hockey and how acts such as bodychecking are a manifestation of these meanings, not standalone behaviours. Regnier et al. (1989) conducted a comparative analysis of bodychecking and non-bodychecking leagues and stated that "when bodychecking is allowed, a general increase in penalties seem to follow, particularly those of an aggressive or hostile nature, which are more likely to injure the opponent" (p. 97).

Creating an injurious environment

Hockey has already been identified in the literature to have a high rate on injury compared with other sports. There have been varying mechanisms of injury, but consistent is the prominent effect physicality has on contributing to these high rates. With bodychecking associated with increased hostility, the role physicality plays in injury becomes more devastating. However, sociologist have also drawn other associations to bodychecking and have documented the tremendous influence that gender, parents, coaches

and sporting cultures have on the formulations and constructions of pain and injury. Such influences have transformed hockey into a violent contact sport and have created an injurious environment.

Gender**.** The sport playing field has throughout time been a critical site for the constructions of gender. To help explain gender as a social construction Horrock (1994) states "gender itself can be seen as a tissue of fantasies about how men and women should act, dress, move, speak, feel, and think. But when we say that gender is a fantasy, we do not mean that it is fallacious or wrong or illusory" (p. 18). Hockey contributes to the creation of gender and Robidoux (2001) explains that "those who establish themselves in 'forceful and space occupying ways' learn to associate such behaviour with being a man" (p. 141). Similarly, Weinstein et al. (1995) share a similar view: "hockey violence partially stems from a players' adherence to beliefs about appropriate masculine behavior" (p. 843). Sabo (2004) discusses masculinity in terms of traditional patriarchal masculinity and relates it back to injury by introducing the 'pain principle' that he describes as: "a patriarchal cultural belief that pain is inevitable and that the endurance of pain enhances one's character and moral worth. Pain is regarded as more important than pleasures and sacrifice is assumed to be required in order to establish self-worth, social acceptance and status gains" (p. 64). Players in such a context may internalize bodychecking as an affirmation of their developing masculinity and provided another theme to incorporate into our semi-structured interview guide.

Parents**.** When youth look for proper ways to think and act, they most often look towards their parents. The role of the parent in youth athletics is more prominent at earlier ages and solely diminishes over time (McCarthy, Jones, & Clark-Carter, 2008). Thus,

parents have a major role in how their children self report positive experiences, and a child's self-reported competence is the greatest indicator of enjoyment (Babkes & Weiss, 1999; LaVoi & Stellino, 2008; Wiersma, 2001). Furthermore, Smith (1978) points out that "one of the role obligations of parents is to transmit to their sons male values and normative standards, some of which promote physical aggression; when insulted, threatened, or attacked by another male" (p. 141). It is the youth's perception of these values and norms that influence their attitudes and behaviours. Kantars and Casper (2008) also documented parental support promoting physicality and explained that, "research has clearly shown that father's interactions with children occur much more frequently in the context of physical play activities while mothers interact with their children within other settings" (p. 72). Thus, parents play a large role in supporting and reaffirming their child's experiences in sport and such a role cannot be overlooked or neglected.

Peers. Fathers and mothers are not the only contributor to the development of a child's self reported perceptions as, "increased levels of violence (especially fist fights), more than playing or skating skills were seen to lead to greater perception of competence by both teammates and coaches" (Weinstein et al., 1995, p. 831). Accordingly, teammates and peers play a large role in how youth interpret notions of pain and injury. Donnelly (2004) illustrates this point by stating: "having one's own identity accepted (confirmed) by a peer group (comradeship) may involve taking physical risks in order to avoid a social/reputational risk – a risk that may be perceived to have even more severe consequences at this time of one's life" (p. 45). So not only do peers reaffirm competence and confirm one's identity, they also create a culture of risk where putting one's body at physical risk is less dangerous than putting oneself in a socially stigmatized position by not taking the physical risk.

Consequently, social acceptance becomes the most valued ideal of young athletes, and one's body is used as an instrument in order to achieve such acceptance. To consolidate acceptance and camaraderie further, Charlesworth and Young (2004) describe playing through injuries: "when asked what motivated them [athletes] to play while injured and in pain, the reason most frequently cited by athletes was not wanting to 'let down' fellow teammates" (p. 166). Therefore, peers play an important role in defining personal perceptions of individual youth and it is important to consider this if we are to look at injuries and injury prone cultures.

Coaches. As well as teammates and parents, coaches also play a role in influencing interpretations of pain and injury (Weinstein et al., 1995). Johns (2004) documented the impact coaches have on young athletes and in particular gymnast who: "under the powerful influence of the coach, work long hours without adequate levels of nutrition of fluid intake to ensure that their appearance meets the requirements defined by judges and endorsed by coaches" (p. 126). The powerful impact coaches have can ultimately lead to youth putting themselves at risk in order to adhere to their expectations and the expectations of their sports. In the winning culture of competitive youth hockey, a coach must get athletes to conform to a set regime and Sabo (2004) describes how such conformity transcends into the adoption of pain and injury: "learning to suppress emotion and deny pain was often done to please the coach. Coaches value the denial of pain because it facilitates athlete conformity and coach control" (p. 68). Vaz (1982) discusses further how coaches suppress emotion and deny pain: "according to one respondent, coaches and trainers are skeptical of newcomers who complain of pain" (p. 36). Again, we see the endorsement and further normalization of pain, as those who do not embrace pain are stigmatized.

Sporting cultures. Commonly associated with pain and injury is aggressive and violent play. The marked difference between the Canadian and the European brand of hockey has shown that North American players play a rougher and more violent game (Grossman & Hines, 1996). What is different is that the Canadian game promotes physicality as part of success and winning. As such, it is important that we recognize how this process is learned and acquired at younger ages and the impact the rougher game has on injury. The data on the constructions of pain and injury in Canadian hockey culture is limited and as Young (2004) suggests: "the physically and emotionally painful ramifications of injury for young and child athletes, and the extent to which sport might be abusive to children's bodies has almost been entirely ignored" (p. 18). In terms of youth hockey, there is evidence that youth hockey players feel it is necessary to play through pain, and in doing so normalize pain and injury as part of hockey playing experiences (Yard & Comstock, 2006). As youth are beginning to formulate their notions of pain and injury, they are inculcated with messages about what injury is from parents, peers, coaches, the media and the sporting community. Through such an array of influences, youth learn to normalize and accept pain as part of the game.

Sociologist have discussed the social process through which pain and injury are adopted and accepted in everyday interactions in the sports of wrestling (Curry, 1993), soccer (Roderick, et al., 2000) and rugby (Howe, 2001). To help explain the overarching structures that influence the adoption of pain and injury more broadly, the work done by Nixon (1992) was influential in creating the term 'sportsnets'. Later Nixon (2004) provided a thorough definition of sportsnets: "the cultural messages justifying risk, pain and injury are communicated within individual sports through social networks called 'sportsnets'...

sportsnets are webs of social interaction directly or indirectly linking members of a social network in an individual sport or sports-related environment" (p. 84). Donnelly (2004) discusses sportsnets as institutions that perpetuate messages like courage, gameness or returning from injury for more punishment, composure in the face of danger, integrity and honesty by not faking or exaggerating injury. The normalizing of pain and injury in hockey is something that has been entrenched in most who have been around Canada's 'game'. Juhn et al. (2002) explained that even violence has become normalized: "it has been stated that violence in ice hockey is institutionalized behavior, and players are socialized products of the larger hockey network" (p. 49). Such messages can be seen to mold and teach as Young et al. (1994) noted: "Such potentially health-compromising norms of masculinisit sport are popularized and reinforced by well-known media personalities such as football's John Madden and ice hockey's Don Cherry, both of whom also rationalize violence and lionize players" (p. 176). Such outside influence promote and create a dangerous sporting arena for youth hockey players. The extent of risk to youth hockey will be explored through combining both quantitative and qualitative methods to holistically study injury.

CHAPTER III: Methodology

The previous chapter identified the various approaches that have been used to identify injury in youth hockey. Quantitative studies have neglected critical situational factors that shed light on how injuries occur, thus calling for more qualitative approaches to be applied. This study employed a mixed method approach that drew from the strengths of both qualitative and quantitative research designs. The mixed methods of both quantitative and qualitative methods responded to the limitations of previous injury studies by not only documenting the frequency of injury, but the manner in which injuries occurred. As a result this study consisted of three data collection methods: (1) observational approach, using video and field notes of each game; (2) post-game injury reporting; (3) semi-structured interviews.

Sample Group

To meet the objectives of this study, we needed to compare sample groups of bodychecking and non-bodychecking play. Bodychecking is only permitted at the competitive levels so for our groups to be identical we needed to focus on competitive leagues. Since this research took place in the Ottawa and Hull regions, it was possible to document three Peewee age (11-14) competitive level teams, one that plays bodychecking hockey in the Ottawa District Minor Hockey Association (ODMHA), one all girls non-bodychecking team from the Ottawa Girls Hockey Association (OGHA) and the other, a non-bodychecking team from the Association du Hockey Mineur de Hull (AHMH). In the province of Quebec, bodychecking is not introduced until the Bantam (14-15) level, whereas in Ontario, bodychecking since 2008 is introduced at the Peewee (11-12) level. In addition

to providing an important comparative dimension to the study, there are important questions currently being raised by hockey practitioners and academics about when bodychecking should be introduced in minor hockey. This study provided comparative injury data between identical age groups and skill levels in bodychecking and non-bodychecking leagues.

Three Dimensional Multi-Method Approach

First dimension: Observations and observation grids

Observations: Most hockey injury inquiries, like other youth sport injury studies, have focused primarily on medical based reports where other less visible injuries like "bruises, scratches, cuts" are overlooked (Dumas & Laforest, 2009, p. 24). Observations in natural settings are useful to analyze injury and can make a great contribution to the quantitative enumeration of injury. Dumas and Laforest observed injuries in skateparks where only 1% of injuries received medical attention. In a context of hockey where it is well known that players are often encouraged to play through pain and injury, direct observations were important to document what might not have been recorded as an official injury through traditional enumerating approaches. Further and more directly related to hockey, Williamson and Goodman (2006) achieved success in their study of injury in youth hockey by combining official injury reporting sheets and retrospective player surveys with direct observations of on ice play. The authors claimed that the observational component was necessary as it allowed them to characterize concussions through observing rapid acceleration and decelerations of the head which lead to trauma and injury. From such a study a more qualitative injury definition was formed: "a head incident of concern, or incident, was defined as a physician diagnosed concussion or an episode considered

seriously indicative of a concussion based on observed signs or symptoms" (Williamson & Goodman, p. 129). Without the observation component to complement the medical assessment of a concussion, it would be difficult to assess all injuries. Further, without seeing the injury first hand it is difficult to determine exactly how the play on the ice led to injury.

In observational studies the ability of just one researcher to collect all data in all places is virtually impossible, thus requiring a team approach to data collection (Laforest and Dumas, 2003). A team of volunteer research assistants were assembled and trained on how to use the observation grids and structured interview guides. The research team comprised of graduate students and undergraduate students from the University of Ottawa whom attended all games. Team leaders were assigned to each team and I personally managed the boys bodychecking group in Ontario. The team leaders were all graduate students with the exepction of one undergraduate student who co-lead the girls non-bodychecking group. The research team also videotaped all games to assist in post-game analysis and as Giorgi and Giorgi (2003) explain: "it is even possible to videotape the behaviour of others and then replay it and establish behavioural meaning units rather than verbal ones" (p. 31). The retrieval of video evidence enabled a frame-by-frame analysis of all on ice play to better understand why and how injuries occurred. Most importantly, reviewing video allowed us to understand exactly what led to injury and as Parkkari, Kujala and Kannus (2001) point out: "careful video analysis of the mechanisms of sports injuries would likely reveal new ways to decrease the number of injuries" (p. 993). From observations through video evidence and direct observation of game events, extensive field notes were taken to aid in describing and analyzing the surrounding influences contributing to injury in youth hockey.

Observation grids. To systematically observe the multifaceted events that transpire over the course of a hockey game, this study implemented an observation grid (Appendix A) to document all observed injuries. The observation grid has been informed by previous observational studies, most notably, the injury severity grid which Laforest and Dumas (2003) designed for their study on skateboarding. Through the severity grid it was possible to determine whether or not the injury was: (1) slight injury (need comforting from team trainer); (2) medium injury (First Aid or minor injury); (3) severe injury (First Aid or major injury); (4) very severe injury (medical attention needed). Sociologists have noted that injury and the personal emotional ramifications of injury in youth sport have been, and still are, almost completely ignored (Young, 2004). Thus through the proposed classification of injury, injury could be documented whether the player reported it or not. In addition to the first aid severity scale used by Laforest and Dumas, (2003), a time lost component was incorporated into the observation grid, which has been used by the Canadian Intercollegiate Sports Injury Registry (CISIR). An injury according to the CISIR is "any injury resulting in one or more complete or partial sessions of time loss" (Meeuwisse, Sellmer, & Hagel, 2003, p. 380). Such a notion of time loss due to injury has been a successful method to diagnose severity of injury in other sport injury studies (Messina, Farney & DeLee, 1999; Schick & Meeuwisse, 2003).

To move beyond injury severity and into situational contributions to injury, legal and illegal play was documented. Literature has shown that simply reviewing penalties does not account for all aggressive acts (Kelly & McCarthy, 1979; Russell & Russell, 1984; Vokey & Russell, 1992). Therefore, a more functional analysis of aggression was needed and the observational system developed by Brunelle, Goulet and Arguin (2005) to document

Adversary Interactions and Nonconformity with the Rules (AINR) proved useful. Brunelle et al. describe AINR as: "instrumental transgressions tied to game play, and non-instrumental transgression tied to players' emotional reactions" (p. 296). Although such an observational system was used to classify violations of rules, a modified version was used in the current study to observe injuries that occur from incidents that are either part of the game (instrumental transgressions) or not part of the game (non-instrumental transgressions). Such information assisted in determining the effect style of play had on injury rates, and determined whether or not aggressive play influenced injury rates.

To categorize situational factors leading to injury we drew from previous epidemiological based studies which identified the following mechanisms of injury: Contact with another player (Agel et al., 2007; Marchie and Cusimano, 2003); contact with stick or puck (Agel et al.; Stuart et al., 1995); contact with ice (Smith et al., 1997); and contact with boards (Boden & Jarvis, 2009; Juhn et al., 2002). Categorizing injuries is critical in order to systematically determine primary causes of injury and to discover any trends that might be evident. Interestingly, our reporting system needed to be amended over the course of the study to accommodate new mechanisms of injury that were reoccurring over the season. With regards to the amendments, the most notable was the combination of player and board contact as a specific category. This was important as no previous injury literature found or used player/board contact as a mechanism of injury. The high frequency of this mechanism of injury found from direct observations shows the importance of actually witnessing injury first-hand by researchers.

Second dimension: Post-game injury reporting (PGIA)

In order to gain an accurate assessment of injury, the PGIA (Appendix B) was conducted with players who missed at least one period of game play or more as result of unwanted physical trauma. Williamson and Goodman (2006) reported in their hockey injury study that the use of "self reported incidents suggests that many players (elite and non-elite alike) recognize when they have sustained a significant hit to the head that presents signs and symptoms of a concussion" (p. 130). Thus, for the most part, players know when they have received a substantial injury and thus our research group allowed the PGIA to record such injuries. The PGIA was implemented after the specific game in which the injury took place which took approximately 5 to 10 minutes. The team trainer was responsible to complete the form for each player they attended too that missed a period or more away from game play. The PGIA was intentionally short to avoid holding up parents and players after games. The intention was to simply gain a quick assessment of the injury and to be able to get information that could not be retrieved through video review.

The PGIA guide resembled the Injury Surveillance Sheet (ISS) developed by Dick et al., 2007), but was altered to document injuries in the sport of hockey. The modifications to the ISS included a classification of specific and less specific injuries to categorize injuries (Smith et al., 1997), and a breakdown of areas of the ice (Gilbert and Trudel, 2000). For each classification of injury there was associated anatomical scale developed by Smith, et al. (1997) that characterized specific body parts (knee, thigh or groin, shoulder, hip, arm/elbow, head, spine, chest/rib, fingers, chin, wrist) or less specific body parts (contusion, sprain, strain, laceration, fracture, dislocation, concussion). Although our usage of Gilbert and Trudel's map was different, the applicability and knowledge that was gained through

creating locations for injury was important and useful. Through both observed injuries and the PGIA, injury can be thoroughly enumerated beyond traditional medical based approaches.

Third dimension: Semi-structured interviews

To gain a deeper appreciation of injury in its broadest sense, semi-structured interviews were conducted with parents and coaches. Semi-structured interviews are useful as Smith and Osborn (2003) state: "it facilitates rapport/empathy, allows a greater flexibility of coverage and allows the interview to go into novel areas, and it tends to produce richer data" (p. 57). The purpose of these interviews was to get implicit detailed meanings of injury to comprehensively understand the injury experience. As the observational component portion of the study unfolded, and greater rapport with team staff, parents, and players was achieved, the semi-structured interviews were expanded to account for new findings from observations. The reasoning behind the requested interviews with parents and coaches is because parents (Babkes & Weiss, 1999; LaVoi & Stellino, 2008; McCarthy et al., 2008; Smith, 1978) and coaches (Johns, 2004; Sabo, 2004; Vaz, 1982; Weinstein et al., 1995) have an important role in creating the hockey experiences whether positive or negative. Longer interviews will not be requested with the actual players because of the sensitivity around injury at young ages and the inability of young players to critically look at their situation. We do not expect youth to openly discuss their thoughts of the hockey environment openly as there are overarching influences that are molding and condition youth to act and think a certain way. For example youth are not able to explain why hockey is a still a sport which condones aggressive behaviour in a world where "corporeal punishment is no longer acceptable in schools; the police and courts have cracked down on domestic

violence; and many schools and communities have instituted ‘zero tolerance’ policies to violence” (Robidoux & Trudel, 2006, p. 101). To understand how violence and aggression remains rampant in hockey and not society at large and how the normalization and acceptance of pain and injury for our Peewee hockey players is construed, we needed to learn from the creators of such constructions, i.e. parents and coaches. With an indentified culture being susceptible to injury, Hutchison, Mainwaring, Comper, Richards, and Bisschop (2009) concluded that there are deeper emotional issues related to injuries, which warrants interviews surrounding the impacts of injury on youth.

To collect information surrounding a culture of pain and injury, interviews were conducted in a location of the participant’s choice, either after the game at the arena in a private area, or in a different locale. Interviews discussed in this thesis were conducted only with parents and coaches from the bodychecking group. The reason for this was the high frequency of injury in this group and to meet the primary objective of this research which was to understand the constructions of pain and injury. The interviews took about thirty minutes to an hour. The interviews focused on topics such as bodychecking, perceptions of injury, how injury affects individual participation rates, injury history, the general culture of hockey and where injury and the risk of injury fit within it. As we received injury data from the longer semi-structured interviews differing theoretical approaches, in particular discourse analysis, was utilized to deconstruct and analyze the injury information. The questions complimented and expanded on other parts of the study to totally understand how youth coped with injury and how it impacted their hockey experiences. Also, we wanted to understand if the injuries led to negative experiences of hockey, which may ultimately influence participation and dropout rates.

The issue of injury in youth sport is gaining greater public notoriety as more publicized and higher profile cases of injury are being reported. The proposed multidisciplinary methodology with the support of the ODMHA, OGHA and AHMH associations, provided injury data to compare non-bodychecking leagues with bodychecking leagues of the same competitive level and girls' leagues. Additionally, the aspect of field notes and interviews provided critical contextual data around injury that medical based injury reporting studies have neglected. The information amassed over the course of the year also provided direction to hockey practitioners to enhance the safety and well being of youth hockey participants.

CHAPTER IV: Putting Youth at Risk

Introduction

Hockey is a game celebrated for its intensely physical nature and the challenges it poses for varying levels of athletic capabilities. Along with these challenges comes the potential risk of injury, which has been the focus of popular and scientific debate over the past 40 years. Recently, hockey in Canada has undergone significant public scrutiny as a result of a barrage of incidents causing serious injury, and in one case, a fatality. For example, 16-year-old Ben Fanelli sustained skull and facial fractures after receiving a bodycheck in an Ontario Hockey League (OHL) game in the 2009/2010 season. Following the severe injuries sustained to Ben Fanelli from receiving a bodycheck, the OHL commissioner was cited afterwards saying: "Send out the message to all our players and minor hockey players that we have to be respectful, more respectful, of our opponent" (Branch, 2009). Also in 2009, 20-year-old Don Sanderson passed away as a result of trauma to the head after falling on the ice during a fight in an Ontario Hockey Association game. Steve Cardwell, president of the team for which Sanderson played, said in response to the event:

> Any time a tragedy like this happens—and it could have been prevented by a number of rule changes, or the way helmets are made, or the way that they work—that debate needs to happen, because if you lose just one life and you don't learn from it, then we're all making a big mistake (Cardwell, 2009)

Similar incidents of violence causing injury are on the rise at the professional level as well. The National Hockey League (NHL) held lengthy general managers meetings in the 2009/2010 hockey season to address the issue of high velocity bodychecks that impact the

head and that have resulted in numerous concussions. Prominent examples from the NHL include Marc Savard and David Booth, both of whom missed a great portion of game-play due to concussions from bodychecks (Dreger, 2009).

The recent public scrutiny of injury in hockey is forcing amateur and professional associations to re-evaluate rules in order to mitigate the risk of injury. One such league, the Quebec Major Junior Hockey League (QJMHL), in the 2008 hockey season had one of their players charged with assault during a hockey fight in a sanctioned game (The Canadian Press, 2008). The incident was so large that the Quebec provincial government ordered the QJMHL to review its fighting rules (CTV News, 2009). The National Hockey League (NHL) also received a stern message from Prime Minister Stephen Harper, when they deemed a hit that caused a player to suffer a severe concussion and broken vertebra during a sanctioned game as a 'hockey play' (The Canadian Press, 2011). This is an opportune time for researchers to contribute to this discussion so that factors associated with injury can be exposed and ultimately reduced. With this said, most research exploring injuries in hockey focuses on frequency rather than the contributing factors. These studies of both amateur and professional hockey have revealed important data about rates of injury and the types of injury that athletes experience, but have generally failed to produce contextual details surrounding injury.

To respond to this lacuna in injury data, our research approach has been to explore injury from a more comprehensive perspective. Working from existing injury studies and implementing a mixed method observational design, this article will provide critical details about the frequency, type, and situational factors of injury for three Peewee aged teams in Ontario and Quebec. Further, we will show how bodychecking hockey puts youth at an

increased risk of injury and explain what those risks are. By doing so we will demonstrate the effectiveness of our injury reporting system, which moves beyond previous reporting methodologies.

Review of Current Injury Reporting Practices

To better explain the challenges and limitations pertaining to prior research investigating injury, it is important to discuss the various ways in which injury is typically reported. Reporting practices have been segmented into two compartments: (1) Retrospective secondary reporting and (2) Prospective voluntary reporting. Retrospective reporting allows for the largest statistical data pool as injury information is collected from existing databases, emergency departments and insurance claims. Prospective voluntary reporting is similar to retrospective reporting in that both share a similar definition of injury whereby a player must visit a medical institution for an injury to occur. The major difference between the two is that in prospective reporting, researchers study a selected team(s) or association(s) and data is collected during the season and/or subsequent seasons of play. In highlighting the limitations of both types of reporting systems, we are able to reveal our own more extensive reporting system. Our prospective observational method of reporting is a more flexible method of reporting injury where researchers are able to define an injury situation that does not require a visit to a medical institution thus allowing researchers to observe an injury without the player voluntarily reporting it. By exploring the varying methodologies of reporting injury, the limitations of secondary and voluntary injury reporting are exposed, paving the way for more in-depth measures to ascertain injury and the contexts of injury more effectively.

Retrospective secondary reporting

Retrospective secondary reporting focuses on injuries that have been documented by emergency departments or insurance claims. Such injury information relies on self-reported injuries, where the player willfully visits a hospital and/or is recommended to visit emergency departments from coaches, team trainers or parents as a result of injury. Additionally, retrospective designs can be done through surveying players at the end of a season to document how many injuries they recalled over the course of their season. Accessing such injury databases provides researchers with a large data set where extensive statistical analysis can be conducted.

The largest injury studies are those that rely on existing databases to determine injury rates. Yard and Comstock's (2006) seminal review of hockey injuries in the United States collected all injuries reported to United States emergency departments from 1990-2003. From this study, a total of 172,128 estimated injuries occurred during ice hockey. From these estimations of injury there is a lack of important detail as only 6.8% (11869 injuries) had an associated anatomical location and physician diagnosis associated with injury. Further, only 1.2% of all estimated injuries (1841) contained enough information to determine the mechanisms of injury. Although frequency of injury is well documented here, the details surrounding injury are virtually non-existent.

In Canada, McFaull (2001) reviewed the Canadian Hospitals Injury Reporting Prevention Program during the 1998/1999 season, which was later analyzed by Macpherson, Rothman and Howard (2006) over a seven year span between 1995 and 2002. Macpherson et al. were able to identify that hospitals in jurisdictions that allowed bodychecking had significantly more injuries than hospitals in jurisdictions that did not allow for bodychecking.

Although the researchers were able to establish frequency, they were not able to provide contextual details to help reduce injury. To highlight the limitations of emergency departments sport injury recording forms, the Canadian Institute for Health Information (CIHI) (2003) collected hospital reports from Ontario alone. From this information the CIHI identified three mechanisms of injury: Contact with player, contact with stick and contact with puck. This research was able to vaguely provide predictors of injury, but having only three classifications does not provide enough contextual information to provide policy or recommendations to reduce injury.

Emergency departments are not the only databases that are mined for injury data; Molsa, Kujala, Myllynen, Torstilla and Airakinen (2003) assessed injury rates at all levels of Finish hockey through insurance data claims. Likewise, Montelpare and McPherson (2004) used injury insurance claim databases to assess minor hockey injuries through the Canadian Hockey Association (CHA) and overlapped this reporting with self-reports of injury. Unfortunately, there was a serious lack of information provided as Montelpare and McPherson could not identify 54% of musculoskeletal locations of injuries in their control group and classified the undetermined bodily locations as “other”. Without actually observing the injuries, they were unable to accurately assess injury, which demonstrates the limitations of using this type of reporting system. Montelpare and McPherson also used self reported injuries to overlap the CHA injury insurance reports and they found to drastically different results. Using only the CHA injury insurance database, Montelpare and McPherson found no difference in injury rates between bodychecking and non-bodychecking play. However, when looking at the self-reported injuries from the selected teams, Montelpare and McPherson reported 704 injuries from bodychecking hockey and 120 injuries from non-

bodychecking hockey. The discrepancy in injury rates between self-reports and the CHA injury insurance reports are alarming and its inability to provide detailed injury information is also startling and demands more rigorous methods to assess injury.

The CHA Injury Insurance Program is designed to supplement personal insurance as Hockey Canada (2010) states: "If you have access to any other insurance you must pursue it through them first. Hockey Canada shall cover those costs not covered by your primary insurance to our policy limits". With Canada having a publically funded health care system, most standard medical costs would be covered under provincial insurance. Further a large portion of the CHA injury report is reserved for dental claims and all minor hockey players wear full facial protection, which virtually eliminates dental injuries and so dental insurance claims are very rare. That being said, it is very important to have an insurance program in place to help families pay for devastating injuries. However using the database to understand injury is problematic, since it is not a record of injury, but rather of claims filed for specific injuries. Therefore, large data pools such as these can be created though retrospective secondary reporting, but the accuracy of this information warrants greater scrutiny.

The last method of retrospective reporting is through surveying. One example of this Emery, Meeuwisse and McAllister's study (2006) which involved surveying 2873 adolescents from 24 Calgary high schools to compare injury rates in different sports. From this large sample, Emery et al. were able to conclude that hockey was one of the highest risk sports played in high school (alongside men's basketball and football). In such a study, it is important to assess how injury in hockey compares to other sports in terms of injury rates and severity of injury. However, Emery et al. acknowledged limitations to the study as a

result of their retrospective surveying and stated that: "The precision of the information presented may be subject to bias due to the nature of the self-report survey technique used" (p. 25). Self-reporting injury is convenient for researchers but generally leads to underreporting. Consequently, using both databases and retrospective self-reporting recall to study injury creates secondary injury information that does not account for all injury and lacks descriptive factors that can only be acquired through prospective research.

Prospective voluntary reporting

The second type of injury research is prospective voluntary reporting whereby researchers establish an affiliation with teams or associations, who in turn, report injuries directly to researchers. Collecting injury information throughout the year means that these types of studies collect primary injury data and not secondary retrospective data. Such studies have used the same definition of injury reporting as retrospective reporting, whereby an injury is defined as physical trauma causing a player to miss a certain period of time away from hockey and the requirement that the player sees a physician as a result of the physical trauma. Prospective reporting can better document injury, as researchers are part of the reporting process and coaches, parents and players are more likely to report an injury when researchers are closely monitoring their season of play. Further, a well-designed prospective reporting system can locate important information relating to mechanisms, musculoskeletal locations and characteristics of injury.

Recently, Emery et al. (2010) studied 2154 Peewee age (11-12) hockey players in Calgary where bodychecking is permitted and in Quebec where bodychecking is not introduced until Bantam (13-14), to see if there were differences in injury rates. It was the responsibility of the partnering hockey teams' trainers to document and submit the injury

report to the research team, which Emery et al. acknowledge as one of their limitations: "With a therapist present at only one session each week, it is possible that minor injuries maybe have been underestimated" (p. 2270-2271). Since injury information was reported once a week and researchers did not actually attend games, detailed injury information was not acquired. Similarly, Darling et al. (2010) conducted a 5-year prospective study on youth hockey. Interestingly, there are disparities between these two studies: Emery et al. reported that bodychecking is the leading cause of injury (intentional contact) where Darling et al. reported that 66% of all injuries resulted from unintentional contact (which included contact with boards or ice). It is difficult to scrutinize such a discrepancy since injuries were reported from team officials and only later validated secondhand by physicians or researchers. Neither of these studies involved firsthand observation and provided little in the way of description about the injuries themselves. For example, they failed to provide critical information pertaining to the type of contact (i.e. struck by puck, struck by stick or a combination of player and board contact). Moreover, there is information lacking in regard to the location on the ice where injuries are occurring or if injuries are happening on legal/illegal plays. Such information is difficult to assess without direct observation and comprehensive recording of on-ice activity.

With a much smaller sample size, Smith, Stuart, Wiese-Bjornstal and Gunnon (1997) had 3 varsity and 3 junior varsity high school teams participate in their study of injury. This study was categorized as prospective voluntary as they followed the teams for one season and recorded injuries that were voluntarily reported by players to team physicians. There were three important outcomes from the study: Classifications of musculoskeletal locations of injury (head, knee, wrist, etc); characteristics of injury (concussion, contusion, laceration

etc.); and mechanisms of injury. However, the authors went even further and made recommendations about equipment changes, rule enforcement, and the need for more training about delivering and receiving bodychecks. They also suggest the Fair Play program, a program introduced to deter violence and aggression, would be a good place to start interventions to reduce injury in hockey. While there might be some merit to these suggested interventions, it is difficult to determine how such assessments could have been made without the researchers actually observing the style of play and witnessing what actually transpires over a course of a hockey game. To offer recommendations that might reduce the risk of injury it is necessary to comprehensively examine contextual factors (e.g., aggression, violence, legal/illegal plays, and delivering/receiving bodychecks) surrounding injury. In other words, it is critical for researchers to move beyond quantitative assessments of injury and begin to qualitatively examine how injuries are occurring within the context of the game.

Methods

The objective of this study was twofold: To compare the rate of injury between three leagues; and to document the situational factors contributing to injury in all leagues. The rate of injury was defined as the number of injuries for each team divided by the number of athletic exposures (A-E) for that particular team. Borrowing from Dick, Agel and Marshall (2007), athletic exposure is defined as a player participating in one practice or competition where they are exposed to the "possibility of athletic injury regardless of the time associated with that participation" (p. 174). Injuries were presented per 1000 A-E's so that statistics could be compared between groups as well as with other studies using the same

format (Agel, Dompier, Dick & Marshal, 2007; Powell & Barber-Foss, 1999; Turbeville, Cowan, Owen, Asal & Anderson, 2003).

In total there were 56 games observed: 25 games from Team 1 bodychecking boys(323 athletic exposures and 1200 playing minutes); 12 games from Team 2 non-bodychecking boys (168 athletic exposures and 432 playing minutes); and 19 games from Team 3 non-bodychecking girls (300 athletic exposures and 608 playing minutes). All teams consisted of 15 skating players; no injury data was collected for goalies. All players were between the ages of 11 and 14. The University of Ottawa Research Ethics Board approved all research and players, parents and team staff/coaches provided informed consent.

From evaluating the limitations of both retrospective and prospective research designs, it was imperative for our group to develop a new research model that would offer a more comprehensive injury reporting system. By using a mixed-method approach, we sought to quantify mechanisms of injury, characteristics and musculoskeletal locations of injury and qualify ice injury locations, transgressions leading to injuries and further descriptive analysis of injury. The research utilized an observational approach, whereby researchers attended each game and implemented a video recording system and extensive notation on all aspects of on-ice play. The video recording system allowed for intra reliability with the research team members reviewing each injury multiple times and inter reliability with the team agreeing on what is and what is not an injury. In order to document injury we utilized voluntary and involuntary reporting practices. In an environment where it is well known that players can be encouraged to play through pain and injury (Vaz, 1982; Yard & Comstock, 2006), involuntary reporting of injury is necessary. Involuntary reporting was done through observations of game play where researchers attended and videotaped all

on ice activity. All injuries were recorded through the use of observation grids created for the study. For more serious injury, a Post-Game Injury Assessment (PGIA) was completed. Our definition of injury was any physical trauma that occurred over the course of the game whereby a player: (1) Needed comforting; (2) missed a shift; (3) missed a period; (4) missed a game; (5) missed consecutive games. The classifications of needing comforting and missed shifts were built around previous observational studies by Bernard, Trudel, Marcotte and Boileau (1993) and Dumas and Laforest (2009) and our time missed portion of the injury definition was informed by previous epidemiological studies (Meeuwisse, Sellmer, & Hagel, 2003; Messina, Farney & DeLee, 1999; Schick & Meeuwisse, 2003).

Game observations

Researchers along with a team of volunteer research assistants comprised of graduate students and undergraduate students from the University of Ottawa attended all games. For each observed game there were three research team members present with specific tasks; two of the researchers were responsible for videotaping game play while the third, the most senior of the group, was given the task of taking extensive field-notes. The cameras were stationed at opposite ends of the rink to most effectively capture all areas of the ice. The footage was then downloaded into Final Cut Pro Editing Software® and then all injuries were subjected to a frame-by-frame analysis to better understand how and why injuries were occurring. Fieldnotes were used to document the circumstantial factors surrounding injury to improve the analysis even further (i.e., levels of aggression, time of game and other circumstances leading to injury).

Observation grids

The research team was responsible for observing and documenting when players experienced some type of physical trauma as a result of game play (athletic exposure). To categorize situational factors leading to injury, we drew from previous epidemiological based studies which identified the following mechanisms of injury: Contact with another player (Agel et al. , 2007; Marchie and Cusimano, 2003); contact with stick or puck (Agel et al., 2007; Stuart, Smith, Nieva, & Rock, 1995); contact with ice (Smith et al., 1997); and contact with boards (Boden & Jarvis, 2009; Juhn et al., 2002). Categorizing injuries is critical in order to systematically determine primary causes of injury and to discover any trends that might be evident. Interestingly, our reporting system needed to be amended over the course of the study to accommodate new mechanisms of injury that were reoccurring over the season. With regards to the amendments, the most notable was the combination of player contact and board contact as a specific category. This was important as no previous injury literature found or used player/board contact as a mechanism of injury, and the frequency found from direct observations shows the importance of actually witnessing injury first-hand by researchers.

Another factor that can only be identified through direct observation is the issue of aggression and violence. Previous studies (Colburn, 1986; Smith, 1974) have identified aggression and violence as the leading contributors to injury, which we were able to assess through a transgression model derived from Brunelle, Goulet and Arguin (2005) called "Adversary Interactions and Nonconformity with the Rules" (AINR). Brunelle et al. describe their AINR model as: "Instrumental transgressions tied to game play, and non-instrumental transgression tied to players' emotional reactions" (p. 296). Although such an

observational system was used to classify violations of rules, a modified version was used in our current study to observe injuries that occurred from incidents that were either permissible conduct (instrumental transgression) or non-permissible conduct (non-instrumental transgression). Such information was critical in determining the effect style of play has on injury rates, and how aggression may or may not contribute to injury. This allowed us to critique transgressions based on our current knowledge of hockey and most transgressions matched the officials on the ice call of either legal play or penalized play. All members of the team viewed the injuries which provided inter-rater agreement on what constituted a transgression.

Observations enabled us to document injury through a novel reporting scheme that included injury leading to time lost and less severe injuries where players did not miss time and continued to play. Further, we have included in the observation grid the mechanisms of injury and an instrumental/non-instrumental transgression classification, which allowed us to document type of play leading to injury. To further validate our observations for injuries that led to the loss of a period, a game or subsequent games, we incorporated a vigorous three-page PGIA which allowed us to retrieve more detailed injury information (i.e., types of injury, musculoskeletal locations of injury).

Post-game injury assessment (PGIA)

The PGIA was put in place in order to gain an accurate assessment of injury and to provide additional information to our observations of injury. The PGIA was conducted with players who were assessed by the team trainer at some point during the game as result of suffering some physical trauma. Team trainers filled out the assessment after games in which they tended to players in any capacity. The PGIA had a similar format to the Injury

Surveillance Sheet developed by Dick et al. (2007), but was altered to better document injuries specific to the sport of hockey. Included in the PGIA document are two categories of injury developed by Smith et al. (1997) who classified injury as specific and less specific. For each classification of injury, there was an associated musculoskeletal location developed by Smith et al. that is broken down as either a specific body part (i.e., knee, thigh or groin, shoulder, hip, arm/elbow, head, spine, chest/rib, fingers, chin, or wrist) or a less specific body part which was diagnosed from a physician which we labeled as characteristics of injury (i.e., contusion, sprain, strain and/or whiplash, laceration, fracture, dislocation, concussion). The addition of this assessment to data collection allowed us to overlap our observations and provided a highly sophisticated injury reporting system.

Data analysis

All statistical analyses were performed using Statistical Product and Service Solutions software, version 17.0 (SPSS Inc., Chicago, IL). A *t*-test was performed in order to compare the differences in injury rates between boys' bodychecking leagues and boys' non-bodychecking leagues. A chi-square goodness of fit test was performed in order to identify significance in mechanisms, characteristics and musculoskeletal locations of injuries. As significant chi-square results only indicated deviations from an expected distribution, post-hoc tests were performed in order to identify precisely where significant differences occurred. Specifically, standardized residuals were calculated. Standardized residuals are similar to z-scores ($M = 0.00$, SD +/- 1.00) and are considered significant when confidence intervals were $p < .05$ (standardized residuals = +/- 1.96). Thus, a standardized residual of 1.96 or greater indicates significant over-representation compared to the expected distribution. Similarly, a standardized residual of –1.96 or less is indicative of significant

under-representation compared to the expected distribution. Correlational analysis was also performed to determine the relationship of injuries and penalty locations.

Results

Our injury reporting program was put into place over the 2009/2010 hockey season with three associations taking part. Due to delays getting ethics approval from our University's Research Ethics Board, we began the study halfway through the season and consequently missed a few serious injuries that were classified as retroactive and were included in the injury reporting. Further, tournament play was not observed but team trainers completed injury forms that we included alongside retrospetive injury.

Comparing bodychecking vs. non-bodychecking

In total we observed 36 injuries on the boys' bodychecking team, 8 injuries on the boys' non-bodychecking team and 4 injuries on the girls' non-bodychecking team (Figure 1). Comparing only boys hockey there was a significant difference between the bodychecking group and non-bodychecking group in terms of injuries per game when weighted by A-E per game ($t(507) = -9.95$, $p < .01$) (Figure 2). For more severe injuries requiring the use of the PGIA, the boys bodychecking team had a 2.6 fold increase in injuries per game when compared to the boys' non-bodychecking team and a 4.2 fold increase in injuries per game when compared to the girls' non-bodychecking team.

Mechanisms of injury for boys' bodychecking hockey

From all the injuries sustained to the bodychecking group, the leading mechanisms of injury was the combination of player and board contact, which represented 38.8% of all injuries (Figure 3). Contact with an opposing player was the second highest mechanism of

injury at 33.3%. Chi-square analysis found significant differences in the mechanisms of injury ($X^2 = 36.12$, $p < .01$, $w = .93$) and standardized residuals proved that both player/board contact (SR = 3.83) and player contact (SR = 2.75) were significantly over-represented. Further, standardized residuals proved that contact with boards alone (SR = -2.22) and player/ice contact (SR = -2.22) were significantly under-represented. It is evident that player contact is the primary cause of injury in bodychecking hockey as 75% of all injuries resulted from opposing player contact (Figure 4).

Injury severity for boys' bodychecking hockey

Results from the observational component indicated that 72% of all injuries fell under the need comforting or missed shift classification (Figure 5). 28% of injuries fell under traditional time loss classification of injury where players missed a period, the rest of the game played or missed multiples games as result of physical trauma. 91% of all injuries sustained in bodychecking hockey were not reported to hospitals or family physicians.

Types of injury in boys' bodychecking hockey

Breaking down the injuries further, we documented specific muscoloskeletal locations (Figure 6) and characteristics for injuries (Figure 7) that caused players to miss at least one period of play requiring the implementation of the PGIA. Included in this information were retroactive and tournament injury information that we did not officially observe but were documented by the team trainer. From Figure 6 we can see that head injuries were the body part most injured at 56.3%, and strains and/or whiplashes were the most diagnosed of all severe injuries at 43.8%. Chi-square analysis found significant difference ($X^2 = 14.00$, $p < .01$, $w = .94$) in musculoskeletal locations and standardized residuals proved that head injuries were significantly over-repressented (SR = 3.24).

Characteristics of injury had no significant difference ($X^2 = 6.50$, $p > .05$) and thus no standardized residuals were calculated. The single concussion documented occured when a player bodychecked an opponent and then collided with the boards. The three fractures (broken collar bone, ankle, and wrist) all resulted from bodychecks.

Time, ice locations of injury and legality of play in association with injury

From our PGIA, we documented that 69% of injuries occurred in the third period of play in bodychecking hockey. We were also able to localize all injuries in bodychecking using Gilbert and Trudel's (2000) area ice location (Figure 9). Gilbert and Trudel used the map to localize penalties per area and for our study we used the areas to localize injury per area. When comparing injury per area with penalty per area, a significant negative relationship was found ($R^2 = -.85$, $p < .01$): as injuries increased, penalties decreased. We documented that area 6 was the most dangerous ice location with 20.6% of injuries occurring in this location. Further, all areas surrounding the boards had a moderate to high injury frequency with 63.5% of injuries occurring in areas associated with the boards. We also found that 66% of injuries occurred on legal instrumental transgressions tied to game play and 34% were caused by illegal non-instrumental transgressions.

Discussion

From the combination of voluntary/involuntary reporting, the use of direct observation, dual camera system and the overlapping of the PGIA, we were able to comprehensively analyze injury in youth hockey. The frame-by-frame analysis of injury through re-imaging injuries caught by our dual camera system allowed us to validate or ammend our injury reporting. Team physicians and trainers cannot totally recall all

information regarding injury as the speed of the game is too quick to accurately document all injuries and factors leading to injury. Further, it was difficult for team physicians to recall exactly what happened during the injury as they often filled the sheet out at home after the game was over and were not able to recall all details surrounding the injury. The team trainer also had other roles (e.g., filling water bottles, tapeing sticks, and grabbing sticks for players, getting tape for players) and did not witness all game play or all injuries. Research observers are also limited as they cannot see all areas of the ice at once, and only have one chance to view events. Only by reviewing game film were we able to see details that directly impacted injury assessments. From this multi-faceted approach we were able to verify all injuries and all factors that contributed to the injury.

Bodychecking vs. non–bodychecking

We found a large discrepancy in injury rates between bodychecking and non-bodychecking leagues. When looking at athletic exposures compared to all injuries we documented a 2.1 fold increase in injury in bodychecking hockey compared to boys' non-bodychecking and a 7.9 fold increase in injury compared to girls' non-bodychecking hockey. For severe injuries the discrepancy between boys bodychecking grew to a 2.6 fold increase in injury per game compared to boys' non-bodychecking. This is consistent with previous literature, which has found an increased risk of injury in bodychecking hockey (Emery et al., 2010; Macpherson, et al., 2006; Regnier et al., 1989). Our study emphasizes the increased risk of injury and highlights concerns about introducing bodychecking to Peewee aged children. In the following paragraphs we will break down injury in bodychecking hockey to shed light on factors contributing to injury in hope of identifying necessary steps to reduce injury at this level—other than removing bodychecking altogether, which is likely in Hockey

Canada's best interest, but unlikely to occur considering the staunch conservatism that surrounds the sport in Canada (Robidoux and Trudel, 2006. Since the injuries in boys and girls non-bodychecking hockey were limited in frequency and severity, we will solely focus on bodychecking hockey.

Mechanisms of injury

Player contact caused 75% of all injuries in bodychecking hockey and this statistic is congruent with previous studies (Bernard, et al., 1993; Brust, Leonard, Pheley & Roberts, 1992; Marchie & Cusimano, 2003). It is well known that bodychecking causes injury; however, situational factors on how and why these injuries are occurring have not been well documented. By attending the actual games and observing how injuries unfold during the action, we were able to establish that the largest mechanism of injury was the combination of player and board contact at 38.8%. Player on player contact followed at 33.3% and only 2.8% of injuries were caused from contact with boards alone. In previous literature, player contact was the leading mechanism of injury (Agel et al., 2007; Brust et al.; Lorentzon, Wedren & Pietila, 1988; Smith et al., 1997) and board contact, for two studies, was the second most frequent cause of injury (Agel et al.; Smith et al.). Contact with the boards causing injury is under-represented; instead it is the combination of player and board contact that causes the majority of injuries. The omission of descriptively identifying what led to board contact causing injury is significant since contact with boards alone does not identify if a player simply collides with boards as a result of falling, or if there were playing situations that caused the player to hit the boards. In our study, players rarely collided into the boards on their own; there generally involved some prior player on player contact that forced the

opponent into the boards causing injury. To illustrate further, the following are a few illustrative accounts of injury that were documented over the course of the season.

Injury to Player 1: Timing. Timing is a concern with certain bodychecks as players were taught that a bodycheck is permissible within three seconds of an opponent getting rid of the puck. Hockey Canada has now changed this timing rule, and the rule now states that a player must be within one stick length to give a bodycheck to an opposing player after he/she releases the puck. This rule allows a player to 'finish' a bodycheck on an opposing player who had the puck but no longer possesses it. In one particular injury to Player 1, who was at his position along the boards in the defensive zone, the puck came to him and he shot the puck out of the defensive zone, alleviating pressure from him and his teammates. He had his back turned to the play and was facing the boards. As Player 1 opened his body to the middle of the ice a few seconds after clearing the puck, he was bodychecked hard by the opposing defensemen. No longer having the puck, Player 1 was not expecting nor prepared for contact. The opposing player took advantage of the pre-existing timing rule of contact and bodychecked Player 1 hard into the boards. The position of the player also contributed to the injury, as the player who received the check was approximately .75 meters from the boards when receiving contact. As the opposing player bodychecked Player 1, Player 1's feet came off the ice and he fell awkwardly as he collided with the boards. The gap meant that the player was not able to brace himself to support the hit, and instead dangerously fell into the boards. It was noted in the field-notes that these types of plays are difficult to observe for both researchers and parents because of the high risk of injury, and the fact that they have until recently been legally executed. There was no penalty on this play and Player

1 received a sprained shoulder. Player 1 was carried off the ice with help from the trainer as concerned parents watched on.

Injury to Player 2: Giving bodychecks. Just as players receiving a bodycheck are at risk of being injured, so too are players giving bodychecks. One documented case of concussion resulted from a player (Player 2) attempting to bodycheck an opponent into the boards in the defensive zone. After the defensive face off, the puck went behind the net and the opposing player and Player 2 skated towards it. The opposing player got to the puck first and Player 2 followed behind and attempted to bodycheck the opposing player. In doing so, Player 2 was off balance and stumbled before delivering the bodycheck. Player 2's head then collided with the opposing player and bounced off him causing Player 2's head to collide into the boards. Player 2 got up slowly and groggily skated towards his bench. After taking a few steps, Player 2 collapsed to the ground and needed to be helped off the ice by the team trainer.

Player 2 was also involved in another play that left him with a fractured left growth plate on his wrist from giving a bodycheck. On the play, the opposing player was in front of the net attempting to shoot. Player 2, a defenseman, rushed as quickly as he could to bodycheck the player. In doing so he made contact with the player slightly, with his momentum going forward and without hitting the player he fell forward unexpectedly. In order to break his fall, he extended his arms and landed on the ice with all of his weight on his wrist, causing it to break. At first glance the injury looked like it was caused simply by contact with the ice. However by breaking down the injury frame-by-frame, it was evident that it was the contact with the ice, and the contact with a player that caused the injury.

Injury to player 3: Tactical play. It was documented that systems of play are contributing to types and frequency of injury. In particular is the 'dump and chase' style of hockey which involves the attacking team crossing the middle of the ice and dumping the puck into the opposing team's end and chases the puck and defender. Well documented throughout the year were many situations where defensemen were left vulnerable to injury to defensemen retrieving the puck on this particular play as, especially with a well-placed dump-in. A well-placed dump-in occurs when the puck stops against the boards in the corner behind the goal-line. The defensemen must therefore skate back quickly and move the puck before the chasing forward bodychecks him/her into the boards. One particular play this year was especially dangerous and involved one player who received a match penalty on the play. The attacking forward (Player 3) dumped the puck into the corner, and the puck was well placed, nestled in the corner behind the net. Both Player 3 and defending player skated quickly towards the puck. On video review we noticed that the defending player slowed down purposefully, allowing Player 3 to be first to the puck. As Player 3 passed the defending forward, the defending forward sped up again and both players were skating at high velocity towards the puck beside the boards. As Player 3 was close to retrieving the puck about 1 meter away from the boards, the defending player bodychecked him from behind and he crashed heavily into the boards. His head snapped back heavily as it bounced off the boards. Surprisingly, Player 3 got up and other than being shaken up by the play, was not seriously injured. What we took away from this was the obvious high risk of injury on the play, but also the skillful play of one player to not only avoid being hit, but to effectively turn the play where he delivered the bodycheck instead of being hit. Over the course of the year, this particular player received multiple bodychecks on the same type of

play, but in this case he simply made the adjustment of deliberately losing the race to the puck, and was able to give rather than receive the hit. It is logical for Player 3 to intentional avoid injury, as most if not all 11 year old boys do not enjoy getting hurt. Conversely, his own adjustment significantly increased the risk of injury for Player 3 who suddenly sped towards the boards with his opponent behind him rather than ahead of him and thus received the check rather than giving it.

From these examples, we can begin to see how contextual factors are necessary in order to grasp how and why injuries are occurring. It is clear that injuries are not only occurring as a result of receiving bodychecks, but giving bodychecks as well. Further player contact and the combination of player and board contact have been broken down to highlight the problems and complexity of these injuries. It was important to document that the combination of player and board contact was our leading mechanism of injury, but the details as to why these injuries is similarly critical. Players along the boards are particularly vulnerable both when taking and receiving bodychecks. If injury is to be reduced at the Peewee bodychecking level, removing forceful contact around the boards would be the most logical place to begin.

Characteristics and musculoskeletal locations of injury

The types of injury most frequent in bodychecking youth hockey were strains and/or whiplash at 43.8%, which is consistent with previous studies (Lorentzon et al., 1988). Head injuries were most frequent at 56.3%. Interestingly, head injuries in collegiate hockey were reported less frequently than our 11-12 year old age group. Agel et al. (2007) reported that 15.4% of all injuries at the collegiate level impacted the head. Smith et al. (1997) documented even less in high school with only 11.1% of injuries impacting the head, 14.8%

of which were strains and/or whiplashes. In addition to acknowledging the vulnerability of our age group to head injury, it is also important to recognize that injury in hockey cannot be uniformly applied to all ages and skills levels, emphasizing the need to consider age and skill when attempting to develop strategies to reduce injury.

Time of game when injuries occur

Injuries most often occurred in the latter stages of the games, with 69% of all severe injuries occuring in the third period. Previous studies (Brust et al., 1992) have also identified the third period to be the highest risk period of the game. On three different occasions, we documented players who were injured in the third period had already received significant bodychecks earlier in the game but without injury. It may be that as players fatigue they become more susceptible to injury. Further, as games are in the third period of play, play intensifies to ensure victory or to avoid defeat. Perhaps with the escalating intensity of play, competition compromises player safety, making players more vulnerable to injury. In combination, fatigue and increased competitiveness are likely factors contributing to injury. In addition, as games become less competitive nearing the end of games, players take liberties on other players, which fosters more dangerous play. The following example helps explain how this happens.

Escalating risk of injury later in games. Nearing the end of a playoff game with about 10s left, Team 1 (bodychecking) was ensured a loss, losing 6-3. With no chance of winning, the coach for Team 1 put on three players who had seen limited ice time throughout most of the game. These three players were known throughout the season to have a specific role, which was to frequently bodycheck the opposing team. Before the faceoff, the three players motioned to purposefully lose the faceoff so that the other team would take

possession, leaving them vulnerable to be legally bodychecked. Off the faceoff, the center-man pushed the puck forward between the opposing player's legs and both wingers moved in quickly to bodycheck the first player to touch the puck. A few more bodychecks were delivered in this 10s period, and it was obvious these players were out to physically bodycheck the opposing team. With the game beyond reach, players were not afraid of being penalized and hurting their team's chance at winning. While situations such as this were relatively infrequent over the course of the study, it does inform how playing situations effect styles of play and the potential contribution to period, especially in the latter stages of a game.

Ice locations of injury

Working from a penalty location spatial map developed by Gilbert and Trudel (2000), we cross-referenced injury location from our study of the bodychecking group. When comparing injury and penalty assessment, a trend emerges that indicates injuries increase as penalties decrease for all areas of the ice. This finding was particularly surprising as rules are made to help protect players from injury, yet in our study players were injurd significantly more on legal plays than illegal plays. In Figure 9, it is apparent that Area 6 was the most dangerous place on the ice representing 20.6% of all injuries, yet was the least penalized area representing 5.3% of penalty calls. Area 6 is the area along the boards, in the neutral zone, where players are usually carrying the puck and building up speed. With increased speeds, the impacts are more intense than in other areas, especially in offensive and defensive zones where the majority of coaching/systems of play take place. In other words, with less structure, players move more haphazardly through the zone increasing the likelihood of collision. However, one structured offensive zone play originates in the neutral

zone which may result in increases injury. Most teams utilized a standard dump and chase style of play, meaning once over the centre red line, the player with the puck would dump it in so that his other line-mates (one or two depending on the circumstance) could chase for the loose puck. The predictability of the system meant that opposing players recognized the play developing, and would respond by attempting to bodycheck the player while he was in the vulnerable position of crossing the red line to dump the puck in. The following descriptive account highlights a common injury in Area 6.

In Area 6, defense are told to stand up players at the blue line, meaning that they are encouraged to physically prevent players from entering the zone. With oncoming players picking up speed through the neutral zone, it is one of the more difficult plays for defensive players to execute. The situation is even more difficult when the opposition is in the middle of the ice, having the option of moving in any direction. As a result, defensive players are taught to angle the opposing player toward the boards and try to squeeze the player into the boards. In our bodychecking group we had one defenseman, Player 3, who was having problems with this maneuver and early in the season he angled the oncoming forward in the neutral zone towards the boards. The player went along the boards and Player 3 attempted to squeeze him but missed and collided heavily into the boards. Later in the season there was a similar play where Player 3 attempted the same maneuver. He began angling the oncoming forward in the neutral zone towards the boards cutting away the open ice. The opposing player was angled into the boards and with no place to go, he was bodychecked violently by Player 3. With Player 3 skating backwards he had to quickly stop and throw his body at the opposing player. In doing so, his foot jammed into the ice and the total force of the opposing player was absorbed by the foot and broke Player 3's ankle.

Legal/illegal bodychecks

Hockey is often criticized for being a highly aggressive and even violent game. Going into this study, we assumed that aggressive and violent play would be one of the leading contributing factors to injury. To our surprise, the majority of the injuries occurred on legal plays, with only 34% of injuries resulting from illegal play. This is similar to the findings by Lorentzon et al. (1988) who found 39% of foul play caused injury with the majority of injury occurring on legal plays. Similarly, McFaull (2001) reported injuries among players 9–15 years old and found that 45% were caused by legal bodychecks and 8% by illegal checks. Not surprisingly, McFaull recommended that stricter enforcement of rules would not have much impact on injury rates. Brust et al. (1992) did find that only 14% of injuries resulted in some type of penalty. One explanation for this is that the actual rules themselves might need to be modified so that legal plays which are resulting in youth getting injured need to be changed. If hockey officials and the Canadian public persist in introducing bodychecking to youth at this age, existing bodychecking rules need to be critically assessed.

One area to begin reducing injury within the rules of the game is to reduce board contact where we found 63.5% of injuries resulted in zones attached to boards. Juhn et al. (2002) reported that 77% of all spinal injuries in hockey were caused from contact with the boards. Yet according to Gilbert and Trudel (2000) only 37% of all penalties occurred in areas associated with the boards, with the majority of penalties occurring in open ice. Our findings support the recommendations by Agel et al. (2007) who emphasized that preventive efforts should focus on strategies to limit player to player contact in the neutral zone and at the top of the offensive and defensive zones, which our study concluded were the two most

high risk injury locations (Areas 6,7). However, our recommendations are more descriptive and call for reduction of contact in any areas associated with the boards. Considering that the majority of these injuries are occurring on legal plays, it may be necessary to modify the rules for youth players who still are developing skills and coordination. Simply eliminating bodychecking within a specific distance to the boards may be a first step.

Rule changes to reduce injury seem to be the most viable solution as programs to increase fair play have had limited success in reducing injury. For example, the Fair Play Program (Brunelle, Goulet & Arguin, 2005) was introduced in various districts but has had limited success. Brunelle, Goulet and Arguin compared leagues which instituted the Fair Play Program with leagues that did not and found "the FPP had a limited impact on injury rates, as it does not directly target the main cause of injuires, namely body checking" (p. 302). Interventions attemting to make hockey safer have been limited in their effectiveness as Trudel, Bernard Boileau and Marcotte (2000) found that bodychecking interventions have not reduced injury rates. It should be apparent, then, that the existing rules in bodychecking hockey are not satisfactorily protecting youth from injury. If there is to be a serious attempt to reduce injury youth bodychecking hockey, other than removing bodychecking altogether, rule modification appears to be the next best solution.

Limitations

There are certain limitations to this study that must be acknowledged. First, there were initial difficulties getting the research approved by our university's REB which delayed the study by two months. As a result the research began mid-way through the season. Although the research group allowed for retroactive injury reporting to be included in the analysis, we were unable to witness all injuries firsthand.. Second, while all games observed

were video-taped, the differences in arena infrastructure created inconsistencies when recording game play. In some buildings it was difficult to record all areas of the ice, which meant for less optimal camera angles and limited viewing when conducting video analysis. Finally, the comparison between the locations of injuries and the penalty locations developed by Gilbert and Trudel (2006) could have been improved if we conducted our own penalty location assessment over the course of the study and analyzed injury in relationship with this data. The idea to compare injuries with penalties emerged part way through the data collection therefore prompting us to rely on Gilbert and Trudel's study.

Conclusion and Future Directions

Concerns about safety in youth hockey have been openly expressed in public and academic circles, yet the prevalence of injury remains high at both the grassroots and elite levels of the sport. Retrospective secondary reporting conducted by accessing emergency department and insurance claim records have lacked contextual details surrounding injury. Prospective voluntary reporting has improved on this by providing limited descriptive details, but without actually being in the field observing the injuries in context, the impact of this research is limited. Similarly, voluntary reporting practices do little in the way of providing information about what is causing injury, let alone providing accurate data about injury rates due to the tendency for underreporting. Studies with large sample sizes are generally privileged in scientific research, yet these studies are unable to provide the micro-analysis available to smaller qualitative studies.

The comprehensive observational approach utilized in this study proved most effective in understanding not only how injuries were occurring, but how and why they were taking place. The use of our dual video camera system proved to be invaluable as it allowed

us to break down injuries and discover what led to the injury through slow motion analysis. With hockey being such a fast paced game, it is difficult to observe and document injury effectively. Further, it is difficult for team trainers to recall and document injury after each game. Through our multi-method approach we were able to review our *in situ* assessments and provide more comprehensive injury reporting and analysis. This layered approach enabled better documentation of the amount of injuries, the types of injuries and the contributing factors to injury.

Through this study we have shown that bodychecking hockey at the Peewee level has a significantly higher rate of injury than non-bodychecking hockey. Future research however should assess whether injury rates differ at the age when bodychecking is first introduced in Quebec at the Bantam level (14-15 years old). It would be important to know if players with bodychecking experience (Ontario with 2 years experience) would have more or less injuries compared to those the players experiencing bodychecking for the first time (Quebec). We have shown that injury is more likely in the third period of play in bodychecking hockey which is the result of escalating intensity of play. Contact with player in combination with contact with boards was the leading mechanism of injury, which up until now has not been properly identified in previous research. Our study determined that the boards and especially the area along the boards in the neutral zone were the leading areas of injury. Further, this study illustrates the limitations of previous hockey research, which has neglected to provide critical contextual details concerning the manner in which injuries are occurring. We have discussed how issues of balance, coordination and timing impact both the delivery and reception of bodychecks making youth at this level particularly vulnerable. Through the execution of bodychecking hockey, players inevitably put

themselves and their opponents at risk. Future research should consider if giving or receiving bodychecks leads to more injuries. For instance, it would be useful to know if players that give more bodychecks are more or less susceptible to injury than players who give less bodychecks. Also it would be interesting to know if players who avoid bodychecks are less prone to injury then players who embrace bodychecking.

We have identified head impacts were injured more often than any other body part. Further, the most frequent type of injuries was diagnosed as strains and/or whiplashes. The head should be protected, especially at these younger ages, and rules and regulations should begin to modify behaviour that will reduce injury in this location. Further, rules and regulations should consider eliminating bodychecking, or at the very least elimination bodychecking in various areas on the ice. Our study indicated that the most dangerous areas of the ice were the least penalized areas suggesting that merely reinforcing the rules is not an effective strategy to reduce injury or there needs to be a critical look into rule enforcement. Rather, rule changes at this level of hockey are more important to reduce injury. In 2009-10, the National Hockey League (NHL) acknowledged that current rules are not sufficiently protecting professional players, calling into question how these same rules effectively protect youth playing minor hockey. In response the NHL made rules changes to prevent any contact to the head (NHL Rules, 2010). Players in minor hockey have not developed the balance, coordination or timing to allow for full bodychecking. Learning bodychecking is and has been shown to be a difficult process, and the addition of allowing bodychecking along the boards adds more complexity. Eliminating bodychecks around the boards might help reduce injury significantly for players who are first introduced to bodychecking. However, future research addressing the efficacy of on-ice officiating would be useful to

explore further the relationship between injuries and penalties. Assessing on-ice officiating was outside of the purview of this study, but if rules are not being properly enforced by the officials, the problem perhaps may not be with the rules the manner in which games are called. An investigation, with help from a senior official who knows the current hockey rule book, would aid in understanding if penalties are being appropriately called in minor hockey.

Allowing players to negotiate some kind of body contact before full out bodychecking would also be an effective strategy to reduce injury. From our comprehensive injury reporting system we have shown how important observational research is to determine exact causes of injury. From this system we have provided detailed accounts of injury, which have never previously been reported, and from these accounts we can begin steps to reduce injury in youth bodychecking leagues.

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CHAPTER V: Rethinking Aggression, Violence and Injury

Parental Perceptions of a Risk Filed Environment

Introduction

The game of hockey in Canada has been celebrated for its high paced energetic style of play, yet has been similarly critiqued for being overly aggressive and unnecessarily violent (Kelly & McCarthy, 1979; Juhn, Brolinson, Duffey, Stockard, Vangelos, Emaus et al., 2002; Robidoux, 2002; Widemeyer & McGuire, 1993; Smith, Stuart, Colbanson & Kronebush, 2000; Vaz, 1979). Hockey's violent and aggressive style of play have led to it become a 'collision' sport (Marchie & Cusimano, 2003). As a result, there is a very strong correlation between physicality and aggression, prompting Regnier, Boileau, Marcotte, Desharnais, Larouche, Bernard et al. (1989) to state that "when bodychecking is allowed, a general increase in penalties seem to follow, particularly those of an aggressive or hostile nature, which are more likely to injure the opponent" (p. 97). These negative associations have been recently exacerbated with the rash of injuries that have occurred at the elite and grassroots levels of the sport (Covassin, Swanik & Sachs, 2003; Emery & Meeuwisse, 2006; Emery, Kang, Shrier, Goulet, Hagel, Benson et al., 2010; Macpherson, Rothman & Howard, 2006; Regnier, et al.; Yard & Comstock, 2006). King and Leblanc (2006) observed that youth are at particularly high risk of injury, which some studies suggest is due to the high level of aggression and violent play in these minor leagues (Widmeyer & McGuire; Willer, Kroetsch, Darling, Hutson & Leddy; 2005). Marchie and Cusimano emphasize the need to address aggression in youth hockey when they write: "aggression may be a learned behaviour rewarded in sport, youth and the public in general must be educated about its dangers and social unacceptability" (p. 126). Despite public outcry, Young (2004) asserts

that little is being done to remedy the situation: “The physically and emotionally painful ramifications of injury for young and child athletes, and the extent to which sport might be abusive to children’s bodies has almost been entirely ignored” (p. 18).

Adding to the debate about safety in youth hockey is the controversial role bodychecking plays. Hockey Canada and its member associations have struggled with this issue for over thirty years. Up until the early 1970s bodychecking was part of all levels hockey. Concerns about player safety prompted hockey associations to ban bodychecking at the younger levels and introduce it once players have had a chance to develop hockey skills. Other than Quebec, bodychecking is introduced in Peewee (ages 11-12); in Quebec body checking is not introduced until Bantam (13-14). Moves to introduce bodychecking at later stages of player development have faced serious criticism by certain hockey practitioners who argue players should learn to give and receive bodychecks earlier on to better prepare themselves when they are larger and capable of inflicting more harm on one another. In 2002 certain associations catered to these views by lower the age of bodychecking to the Atom age (ages 9-10), only to have this decision reversed two years later because of the ensuing controversy it caused. Within this debate, the only constant has been the mounting evidence demonstrating that bodychecking or player-to-player contact in hockey is the leading cause of injury: Agel, Dompier, & Marshal (2007) indicate that 50% of injuries resulted from player-to-player contact; Marchie and Cusimano (2003) show that 83% of injuries result from bodychecking; and Tegner and Lorentzon (1991) state that 57.9% of injuries were caused by bodychecking. In youth, researchers have determined through comparing bodychecking to non-bodychecking leagues, that players in bodychecking leagues are at a greater risk of injury (Hagel, Marko, Dryden, Couperthwaite, Sommerfeldt and Rowe, 2006;

Macpherson, Rothman and Howard, 2006; Regnier et al., 1989; Tator and Edmonds (1984). With this overwhelming evidence showing that bodychecking clearly puts players at risk of injury, it would seem logical that if one wishes to reduce the risk of injury, one simply needs to remove bodychecking from the sport—at least at the youth levels. In Canada, however, where intensely physical and even aggressive play is valued for both its effectiveness and overall entertainment value, hockey practitioners are reticent, if not completely unwilling to remove what is deemed as a distinctive element of the sport. Efforts to remove bodychecking from youth hockey by researchers and hockey enthusiasts have only made the reactionary core of hockey officials more entrenched in their position to maintain bodychecking. What is certain is that the increasing divide between academic and practitioners is counterproductive and will do nothing to improve the safety of the sport. While our research confirms what other studies have demonstrated, that bodychecking puts youth at a significantly higher risk of injury than non-bodychecking hockey (Boyer, Hancock, Saeed, Adams, Shwartz & Robidoux, forthcoming), we feel that it would be more prudent to work *with* hockey organizations to find solutions to help reduce the risk of injury in hockey. If organizations are unwilling to remove bodychecking altogether, alternative strategies must be devised to reduce injury within the context of bodychecking hockey. #

In response, we devised a study that critically examines injury in youth bodychecking hockey to offer insight into why injuries were occurring and what steps might be considered in mitigating injury. This research was made possible through extensive observations and recording of minor hockey games in the Ottawa and Gatineau region. In partnership with three minor hockey associations in the Ottawa-Gatineau region, a mix-method approach combining observations (extensive field notation and video recording) along with parent

interviews provided important insights about injury and bodychecking in youth hockey. Contrary to previous research highlighting the overly aggressive and violent play in youth hockey, this study suggests that players predominantly engage in the sport positively and play with mutual respect for their opponents. Findings from this study show that the majority of injuries in bodychecking hockey, occurred on plays that were deemed legal by on ice officials and fell within what is generally understood to be the rules of the sport. This suggests that it is not necessarily players' misconduct leading to injury, but rather by playing within the current rules youth are being injured. In other words, the current rules by which youth engage in bodychecking hockey are not protecting them from injury. The overarching purpose of this study is to understand what elements of the sport are putting youth at risk of injury and how youth negotiate risk and hockey efficacy.

Methods

Over the course of the 2009/2010 hockey season, our research group documented three teams: 25 Ontario boys Peewee bodychecking games, 12 Quebec boys Peewee non-bodychecking games, and 19 Ontario girls Peewee non-bodychecking games. All teams represented the highest competitive level in their associations, and for the Ontario boys, it was the first year that bodychecking was introduced. The discrepancy in game totals was based on the fact that the Ontario boys' team was the only team that continued to advance through all of the playoff rounds, therefore allowing us to observe more games. In total there were 56 games observed and videotaped. This paper focuses primarily on the bodychecking observations because of the higher rate of injury that was documented in comparison to the

other two non-bodychecking leagues (Boyer et al., Pending review). All research was conducted under the University of Ottawa Research Ethics Board guidelines.

Researchers along with a team of volunteer assistants, comprised of graduate students and undergraduate students from the University of Ottawa, attended all games. For each observed game there were three research team members present with specific tasks; two of the researchers were responsible for videotaping game play while the third was given the task of taking extensive field-notes. The cameras were stationed at opposite ends of the rink to most effectively capture all areas of the ice. The footage was then downloaded into Final Cut Pro Editing Software® where all injuries were subjected to a frame-by-frame analysis to better understand how and why injuries were occurring. Our definition of injury was any physical trauma that occurred over the course of the game whereby a player: (1) needed comforting; (2) missed a shift; (3) missed a period; (4) missed a game; (5) missed consecutive games. The classifications of needing comforting and missed shifts were built around previous observational studies of injury (Bernard, Trudel, Marcotte & Boileau, 1993; Dumas & Laforest, 2009) and our time missed portion of the injury definition was informed by previous epidemiological studies (Meeuwisse, Sellmer, & Hagel, 2003; Messina, Farney & DeLee, 1999; Schick & Meeuwisse, 2003).

The video editing software aided in describing exact mechanisms of injury which has been recommended by Parkkari, Kujala and Kannus (2001): "careful video analysis of the mechanisms of sports injuries would likely reveal new ways to decrease the number of injuries" (p. 993). Videotaping has also aided in understanding whether or not violence or aggression causes injury which has been successfully assessed through previous research (Cote, Trudel, Bernard, Boileau & Marcotte, 1993). However to measure aggression,

literature has shown that simply reviewing penalties does not account for all aggressive acts (Kelly & McCarthy, 1979; Russell & Russell, 1984; Vokey & Russell, 1992). Therefore aggression was measured through a model derived from Brunelle, Goulet and Arguin (2005) called Adversary Interactions and Nonconformity with the Rules (AINR). Brunelle et al. describe their AINR model as: "Instrumental transgressions tied to game play, and non-instrumental transgression tied to players' emotional reactions" (p. 296). Such information was critical in determining the effect style of play has on injury rates, and how aggression may or may not contribute to injury.

In addition to the observed injury information provided through video frame-by-frame analysis, a detailed injury information document called the Post-Game Injury Assessment (PGIA) was put in place. The PGIA was implemented for injuries requiring at least a period missed as a result of unwanted physical trauma. Team trainers were required to fill out the PGIA after games in which they tended to players. The PGIA was informed by the Injury Surveillance Sheet developed by Dick, Agel and Marshall (2007), but was altered to better document injuries specific to the sport of hockey. For each classification of injury Smith, Stuart, Wiese-Bjonrnstal and Gunnon (1997) proved helpful to categorize musculoskeletal locations and the associated characteristic of injury (i.e., contusion, sprain, strain and/or whiplash, laceration, fracture, dislocation, concussion) that are not easily visible through video review. The addition of this assessment to data collection allowed us to overlap our observations and provided a highly sophisticated injury reporting system.

To gain a deeper appreciation of injury in its broadest sense, semi-structured interviews were conducted with parents from all three teams, but this paper will only focus on the interviews with parents from Ontario boys' bodychecking team. Semi-structured

interviews are useful as Smith and Osborn (2003) state that “it facilitates rapport/empathy, allows a greater flexibility of coverage and allows the interview to go into novel areas, and it tends to produce richer data” (p. 57). Such richness allows for a critique on the amount of violence and aggression in youth hockey and provided an understanding about youth’s new experiences playing with bodychecking. Parents were notified at the beginning of the study that interviews would be conducted with them. Parents were then recruited before/after and during games or practices by the research team based on their availability and willingness to participate. Fourteen players parents were interviewed, including the parents of both goalies, and three parents players were not interviewed or unwilling to participate. A total of 16 parents elected to participate in interviews (6 men and 10 women); two of the players’ mothers and fathers elected to be interviewed together. The interviews took about thirty minutes to an hour. The interviews focused on topics such as: bodychecking; perceptions of injury; injury history; the general culture of hockey and where injury and the risk of injury fit within it (Appendix C). Semi-structured interviews were utilized to ensure a level of consistency between interviews while also allowing for some flexibility to create more of a conversational style of interviewing. Interviews were transcribed and analyzed through standard issue-focused analysis, allowing the interviews to help me understand of the world of youth hockey. Weiss (1994) describes issue-focused analysis as understanding "what could be learned about specific issues—or events or processes—from any and all respondents (154).

Context

The sport of hockey has largely been perceived as an environment that celebrates violence and aggression. Perhaps the 1972 Summit Series displayed this best, where Team Canada defeated the Soviet Union in an eight game series for world hockey supremacy. The clash of political ideologies paled to the clash of playing styles, where team Canada ended up "hacking and clubbing the Soviet players like seal pups and bullying their way to a thrilling, remarkable comeback" (Klein & Reif, 1998, 31). Team Canada was able to show to the world exactly what Canadian hockey was based on:

> In Canada, the rough and often violent games of Rugby Football and Lacrosse had helped inform the sensibilities of those players participating in ice hockey, whereas the Soviets stressed the importance of skating, and the game developed around the Russian traditions of speed and figure skating (Wilson, 2004, p. 274).

Not only was the Canadian game markedly different from that of Russia, but all of Europe as well as Grossman and Hines found North American hockey players play a rougher and more violent brand of hockey than European hockey players (Grossman & Hines, 1996).

Robidoux (2002) traces the violence and aggression of hockey to the game's origins, which have since been institutionalized as part of Canadian culture and identity. Nixon (2004) would describe these cultural attitudes as institutionalized sportnets, which he defines as: "webs of social interaction directly or indirectly linking members of a social network in an individual sport or sports-related environment" (p. 84). Whether directly or indirectly, players are exposed to "cultural messages, norms, and patterns of behaviour" which are eventually internalized by the athletes at an early age (Roderick, 1998, p. 78). It has been argued that the social interaction that occurs in hockey encourages violence and aggression

(Juhn et al., 2002; Robidoux & Bocksnick, 2010). That is to say, socialization creates an environment to accept and sanction violence as part of playing hockey. As a product of this institutionalized violence and aggression, other messages are perpetuated which Donnelly (2004) associates with high risk sport: courage; gameness or returning from injury for more punishment; composure in the face of danger; integrity and honesty by not feigning or exaggerating injury. The significance here is that violence and aggression is being depicted as inherent to the sport of hockey, which in turn is associated with the high rate of injury. It is the linking between these two terms (violence/aggression and injury) and the communication in the social web of hockey that needs to be scrutinized. Recent events have brought alarm to the hockey world, most notably Don Sanderson dying in a hockey fight in 2009 (Cardwell, 2009) and National Hockey League (NHL) players suffering from severe concussion from high velocity and violence collisions (Dreger, 2009). Public reactions to these events have forced the NHL and the feeder Canadian Major Junior Hockey Leagues to seriously consider rethinking rules to mitigate injury (Branch 2009; NHL Rules, 2010). Youth leagues have been virtually ignored from such discussions yet injuries in these minor leagues are rampant (Emery & Meeuwisse, 2006; King & Leblanc, 2006; Yard & Comstock, 2006). From our observations and evaluation of boys' bodychecking hockey, the anticipated violence and aggression in hockey that has been frequently documented by academics (Juhn et al.; Kelly & McCarthy, 1979; Kerr, 2006; Grossman & Hines, 1996) and social media forms (Branch; Cardwell; Dreger) was not evident. Such findings prompted us to rethink its relationship with injury while also investigating other factors contributing to young players getting hurt.

The Perils of Bodychecking Hockey

In game observations and interviews with parents proved vital in understanding injury in youth hockey. From game observations and interviews four key elements relating to youth bodychecking were observed: corporeal management and self preservation; coping with a risk filled environment; the normalization of injury; conflict and vagueness concerning the interpretation of the current rule system; and the necessity for a graduated introduction to bodychecking. Each of these elements will be discussed below.

Corporeal management and self-preservation

The 2009/2010 season brought a tremendous change to fifteen eleven and twelve year old hockey players. This was the year the boys went from non-bodychecking to full bodychecking hockey. Parents believed that moving into bodychecking hockey would be a 'natural' transition where 'boys being boys' would welcome the physical contact. However this was not the case; rather, bodychecking was something unfamiliar to the children as one parent pointed out in an interview: "They haven't figured it [bodychecking] out yet; it's not natural" ***(Heidi[1])***. One of the issues players had with bodychecking was the fear of injuring opponents. Speaking with one of the mothers she explained that her son "doesn't want to hurt other players as Jeff is very sensitive. He's still learning how to bodycheck and his timing is a bit off. He still needs to practice bodychecking" ***(Marlene)***. Another parent told us that: "Big players are afraid to hit and when they do they either hurt other players or get penalized" ***(Katharine).*** Significant here is that players are not only concerned with hurting other players but are also worried about being penalized. According to one parent, the prospect of being penalized for bodychecking was particularly challenging for his son:

> Six to eight weeks into the season he [his son] was still finding his way with the body. There were issues of timing and understanding the window of time where you can finish a check as he thought he would get a penalty for finishing his checks. It was difficult for coaches to get this across to the players that they would not be penalized for giving bodychecks. Once he grasped this concept he created a lot of opportunities and has become as aggressive as originally hoped for. He was not an overly aggressive kid to begin with. He is still not playing quite to the level where coaches and I think he can but he is playing more consistently as opposed to last year. He is continuing to improve and is becoming a more well rounded player ***(Bill).***

Evident from these interview excerpts is the idea that players were not prepared to accept all that is entailed with bodychecking hockey. However, once players more efficaciously manage themselves and the rules around bodychecking it allowed them to become more effective, and as Bill notes, potentially more aggressive.

As stated earlier, issues of violence and aggression have been associated with an increase risk of injury in youth hockey. Kirker, Tenenbaum and Mattson (2000), however, make an important point about how aggression is often confused with assertiveness. They describe assertiveness as behavior that "is not to hurt another, rather be active, determined, and establish dominance. Assertive behavior, typically integral to sporting endeavor, can result in injury but such physical or psychological harm is incidental to play" (p. 373). On the other hand, aggression is defined as a purposeful act that is done with the intention to cause injury, either psychological or physical. In our study, when players asserted themselves physically and injured an opponent, they were not purposefully attempting to

injure, but rather assert themselves and dominate space. When parents were asked how they felt youth executed bodychecking, the following responses were documented:

- "70% of kids are performing bodychecking appropriately; however the 30% of bad checks are mostly late hits." **(Christine)**
- "80% good checks and 20% are not, smaller players hit to the head and bigger players hity with their elbows up." **(Chloe)**.
- "Most of the time bodychecks are executed appropriately but it occasionally happens that the kids do not." **(Ashley)**
- "The kids for the most part are hitting within the rules. The problem is usually with the timing of the hit and when opponents turn around at the last second and the player giving the bodycheck cannot let up." **(Silvia**)

From these comments, we see that parents do not find that hostile aggression is an issue at this level of play. Rather they believe most players are executing bodychecks within the rules of the game.

The coach plays a vital role in influencing the execution of bodychecking and it is in his team's best interest to avoid taking penalties while executing bodychecks.. It adds another layer of information the players need to negotiate, which for some parents proved to be problematic:

> The coach is responsible to control the management of how bodychecking is implemented. When the coach tells Matt to hit, he does not have any malicious intent. He goes out and does his best to take the body and unfortunately got injured doing just that. **(Marlene)**

Marlene's comments reinforce the idea that there is no hostile aggression and malicious intent to injure; rather children are playing inside the rules or assertively and obeying their coach's orders. Playing inside the rules and playing assertively may create a higher level of performance, but it also points to the fundamental problem of injury at this level. In Marlene's example, the player did exactly what the coach told him to do, he went out and delivered a bodycheck to an opposing player to the best of his abilities. In so doing, he stood a player up at the blue line trying to make a huge bodycheck (assertive physicality) and broke his ankle in the process. The example illustrates how players are not breaking the rules and are not playing aggressively, but rather simply following coaches' instructions and asserting themselves on the ice. This is consistent with other studies highlighting the potential for injury on plays that are not in violation of the rules (Brust, Leonard, Pheley & Roberts, 1992; Lorentzon, Wedren & Pietila, 1988; McFaull, 2001). By players simply engaging in the game they are at risk of receiving and/or inflicting injury and must decipher ways to mitigate these risks.

Coping with a risk filled environment

Through game observations, it was evident that players needed a process to negotiate bodychecking, and a similar process to cope with injury. Players have two critical issues to cope with playing bodychecking hockey: first, players need to accept the inherent potential of hurting other players through simple game execution; and second, players in return need to accept the perpetual threat of being injured themselves. The first issue is identified nicely by one parent who talked about the largest player on the team who was "conscious of his size and didn't want to hurt anyone" **(Frank)**. Speaking about the same player, another parent told us that "some players are too nice. Patrick in particular is a big guy but doesn't want to

hurt other kids" **(John)**. Parents' perceptions about Patrick were confirmed by his mother who discussed the challenges her son faced with bodychecking:

> Bodychecking has been a learning curve. Major challenge has been his size. Every time he hits it takes a lot of energy, he has to try to balance hits with playing hockey. He gets frustrated when he hits and gets penalties because he's a bigger player. He doesn't want to be seen as the friendly giant but rather wants to be seen for his skills. ***(Chloe)***

At first glance, Patrick's size advantage makes him an attractive choice for coaches, yet his unwillingness to use his size essentially undermines his physical prowess potential. For Patrick, his size advantage is actually a hindrance to his effectiveness as he is more concerned about hurting other players than on ice dominance. His reputation as being the 'friendly giant' would in any other context be complimentary, but in hockey, it is a shortcoming.

The anxiety that player's face with the potential of hurting others through game play is coupled with the process of learning to accept injury themselves. Questions with parents about the potential of injury in youth hockey provided important information about how children cope with injuries. For the most part, parents claimed that their children not only accepted the potential for injury, but also learned to accept it as part of the game. In fact, in many examples, children were seen playing through their injuries, which research suggests contributes to the normalizing of injury (Charlesworth & Young, 2004; Donnelly, 2004; Sabo, 2004; Weinstein, Smith, & Wiesanthal, 1995; Vaz, 1982). For example, John's son Alex suffered a broken wrist which occurred on an "innocent play. Alex got rubbed out and broke his wrist against the boards but finished the game" ***(John)***. The severity of the injury

did not seem to be of concern to this parent, nor did the fact that his son played the remainder of the game. Instead, the parent expressed pride in the fact that his son continued to play through pain, demonstrating qualities Donnelly (2004) identifies as being emblematic of the ultimate high risk competitor. John describes this learning process as necessary for self preservation and efficacy in youth bodychecking hockey:

> Alex started the year without inhibitions about bodychecking. He took a couple nasty hits at the start of the year. After his broken wrist I thought he would return more timid but he came back like it didn't bother him. I told him to start being the giver of bodychecks rather than the guy always receiving bodychecks and this has helped him. He is playing his best hockey now after being injured before. ***(John)***

A similar coping strategy was documented from another parent who stated:

> No, no worry at all about my son getting injured. I have always stressed 150% effort. He got the work ethic idea very young which is a skill on its own. When you're playing hard you're more resilient to injury. When you play timid it seems like you put yourself at greater risk of injury. He learned to play more aggressive but clean. ***(Bill)***

What parents consistently expressed was that by playing assertively and forcefully, players were not only more effective on the ice but were also less prone to injury. The self preservation tactic of actively initiating bodychecking is supported in the literature as Emery, Mckay, Campbell and Peters (2009) state: "those players with the most positive attitudes toward bodychecking… are not necessarily those who get injured… It is likely that players who are most enthusiastic about bodychecking are more often delivering the bodycheck, potentially injuring others" (p. 213). Interestingly, we observed on two different occasions a

player who received serious injuries—one of which resulted in a broken ankle from attempting to play assertive and deliver a hard bodycheck. This player, despite this self preservation strategy based on increased assertiveness rather than caution, was severely injured. Thus, while evidence suggests it is players receiving bodychecks who are most often injured and most at risk, injuries still occur from delivering bodychecks highlighting the precariousness of bodychecking at a level when basic skill acquisition is being developed.

In addition to playing more assertively, players have other means of negotiating their play in order to avoid and accept injuries. One parent noted how her son changed the way he played the game as a result of injury:

> In minor atom Josh had a mild concussion playing with bodychecking. He was hit to the head on a bodycheck in open ice; it took three months after that to play the game properly again. He was afraid to get hurt after this and it shook him up for a long time. Josh realized he was a target and the longer he held onto the puck, the longer he would put himself at risk of injury. Before the injury Josh carried the puck and didn't pass, since the injury however, he has begun to move the puck more. Minor atom [non-bodychecking] always has star players who are told to take the puck and go. Josh is passing more this year than last year and I am not sure if it's bodychecking or just further development. I am afraid for Josh after the concussion and when players go into the boards fast, I'm worried that he'll get hurt. ***(Katharine)***

For players that get hurt, they learn to modify their play to feel more secure on the ice. In this case Josh learned to get rid of the puck quicker and more often in order to avoid getting hit and injured. Interestingly, this strategy runs counter to adopting a more assertive style of

play which may be the reason the parent was nervous each time players approached her son. In effect, he was employing a defensive strategy of avoidance rather than facing or embracing contact. The point here is not whether such a tactic is or is not effective, but rather that players are consciously adopting strategies to reduce the chance of being hit and injured. How effective this strategy is will only be known as the player progresses in the sport, or eventually drops out due to a fear of being injured.

The normalization of injury

Despite the ever present awareness of injury in youth hockey, those responsible for teaching or assisting the children to play bodychecking hockey did not appear overly cautious or concerned. Instead injuries were construed as infrequent and unfortunate, but something players simply must face if wishing to participate in the sport. When one mother was asked if she had concerns about her son being injured, she responded: "No concerns. The coach has done a tremendous job and the trainer has done a great job making it a safe environment. The trainer has gone to players homes to check on players and has made parents feel comfortable about injuries" ***(Heidi)***. Notice that she concedes that injuries are occurring, but they are accepted because of the care the trainer provides. While the care this trainer provides is of obvious benefit, it simultaneously contributes to the naturalization of injury; implying that injury is inevitable and that one simply need to respond to them as effectively as possible. Such attitudes may suffice for minor injuries such as contusions and slight sprains, but many of the injuries that were sustained over the course of this season were not minor (Boyer et al, pending review). The most frequent type of serious injury sustained were those to the head, which cannot be assuaged through trainer follow-ups or house calls. Cusimano, Chipman, Volpe and Donnelly (2009) discovered that in Canadian

Minor Hockey there are significant misconceptions about concussions from both adults and players, which serve to naturalize this injury. Our research substantiated such a naturalizing process as parents of players who have sustained a concussion were not overly concerned with the injury, noted in this one interview: "Josh had a mild concussion from trying to deliver a hit this year. Later in the day he wanted to play again. It hasn't affected his involvement at all. He actually wants to get the player back" ***(Fred)***. Another parent whose son had suffered a severe injury to his jaw and been knocked out with a concussion said that "injuries have not affected Sylvain; the kid loves hockey" ***(Lisa)***. Injuries such as concussions are not perceived as deterrents to their children's involvement as parents praise their children for wishing to play despite having been injured. If children are aware of the praise associated with overcoming/playing through injury, one has to question how much of an influence this has on the children's actual 'willingness' to return. Notice how this one parent discusses her son's injury which he received through the self-sacrificing act of blocking a shot: "Mike had a big bruise as result of blocking the shot. The injury doesn't bother him anywhere near the rink but at home he is a big suck" ***(Christine)***. The comments heard here could be phrased differently: at home the child acts as a child, but at the rink he acts as he think parents think a hockey player should act.

This idea of tolerating and suppressing injury around the rink can be linked to the fact that players are pressured into acting like miniature adults, which Mike's mom identifies with "the hype of watching the kids play. It gets the parents all caught up causing them to act like they are watching men play hockey" ***(Christine)***. Another parent said: "It doesn't take a lot to break the player's confidence and if the coach is or is not behind them they can feel it. Kids know when the coach is behind them and when the coach is not. Coaches treat

the kids like adults and not kids of their own age" ***(Camilla).*** Further, another parent noted: "Our sons play hockey for 40 minutes, they show they can be a man, then after the game all is forgotten and the man goes back to being a boy, back to playing x-box online against kids they just played hockey against" ***(Heidi)***. The environment of youth hockey teaches young boys that injuries are inevitable and their ability to rise above them demonstrates their worth as players. Further, by suppressing injury players are able to demonstrate their attempts of becoming a man and playing the vernacular game of hockey to its true intentions. Literature has shown hockey to be a dwelling for the construction of a certain 'appropriate' type of masculinity (Robidoux, 2001; Weinstein et al., 1995; Young, McTeer, & White, 1994). Such attempts of masculinity are navigated through a naturalizing process in an arena full of tension and ambiguity in relation to injury and youth in premature adult roles.

Conflict and vagueness concerning the interpretation of the current rule system

Parents and coaches have consensus in that the ambiguity surrounding the rule enforcement of bodychecking is a leading contributor to injury. In particular, parents, coaches and players are never certain what constitutes a penalty and what is considered to be a clean play, especially as it relates to bodychecking along the board:

- There is a problem with hitting from behind and boarding which is brought about by inconsistent officiating. It is very murky what is and what is not a penalty. With the speed of the game, sometimes players turn the wrong way and momentum can't be stopped. It is unusual to see malicious intent. **(Bill)**
- I would like to see more specific penalties on hits to the head, current rules are too ambiguous. **(Lisa)**

There are certain injurious situations that are directly related to bodychecking that coaches condone. In fact, coaches encourage such behaviour because "giving legal bodychecks and avoiding penalties seem to be related to better performance" (Trudel, Bernard, Boileau, Marcotte & Audette, 1993, p. 101). It is important to note here that it is the 'avoidance of penalties' and not the encouragement of 'promoting fair play' that is being emphasized. Players can thus navigate the gray areas and push and stretch the rules as far as possible, thus ever increasing performance. The avoidance of penalties is possible in many ways as Kerr (2006) explains: "there are gray areas, which exist between sanctioned and unsanctioned acts" (p. 320). For example, players are encouraged to 'finish a check' where the player no longer has the puck and is no longer an offensive threat but is punished for having had the puck. The play is penalized if the official deems it was too long after the player got rid of the puck, but rewarded if it falls within an acceptable timeframe—typically three seconds. Within the highly paced play of hockey, a fraction of a second could mean a penalty or a reward. Referees can make this issue even larger as inconsistent penalty calling invites disobedience (Juhn et al., 2002). If players believe they can get away with a marginally legal play, they will attempt to do so within a performance based sport ethic.

Of all injuries documented, play within the rules caused more injuries than play outside of the rules. Further, the leading mechanism of injury was player and board contact which most often occurred from legal play (Boyer et al., Pending Review). One of the more serious injuries that can result from player and board contact occurs when a player hits an opposing player from behind, not necessarily maliciously but as a result of awkward positioning and player vulnerability. Such situations can have catastrophic results as research has shown that 77% of spinal injuries are caused from player and board contact

(Juhn et al., 2002). What is alarming is that hockey has been identified as one of the sports that places participants at the greatest risk of spinal injury (Boden & Jarvis, 2009). Hitting from behind is a highly visible infraction, however, any player and board contact is also subject to penalty (referred as boarding), which has been linked to spinal injuries (Tator & Edmonds, 1984). Throughout this study, player and board collisions causing injury were only penalized if the player checked the opposing player from behind. According to Hockey Canada (2010a) rules, however, "any player who bodychecks, cross-checks, elbows, charges or trips an opponent in such a manner that causes the opponent to be thrown violently into the boards" will be issued a penalty. If the player is injured it warrants a major penalty and a game misconduct (Hockey Canada 2010a). In our study, not only were players not ejected from the game, they were not issued any type of penalty whatsoever. With boarding rarely enforced and not called for any injuries in this study, it is not surprising that there is confusion about the rules from parents, coaches and players.

To add to the ambiguity of the rule system and the issue of boarding, a well documented event occurred during a 2009/2010 Ontario Hockey League (OHL) game where a player delivered a devastating bodycheck to a sixteen year old player who sustained skull and facial fractures. The player received a five minute match penalty for boarding (OHL, 2010). After the OHL reviewed the infraction, the player, who was initially penalized for the hit, was further issued a suspension for the remainder of the 2009/2010 season, including playoffs. What is problematic here was not the call or suspension but the public response which did not support such heavy handed disciplinary action. The most vocal critic was the NHL's Toronto Maple Leafs' General Manager Brian Burke who commented on the suspension:

> Not to be critical of Dave Branch [OHL Commissioner] but I thought it was an awfully stiff penalty for what started out as a legal check. It was a legal bodycheck that went horribly wrong. I don't mean to diminish the injuries the other young man suffered. That could have happened to a lot of players and unfortunately it happened to this kid (McGran, 2010)

Whether one agrees or disagrees with Burke's assessment is not the issue here; what is significant is the subjectivity around what does or does not constitute a penalty, especially around the boards, which this study and others have identified to be the leading injurious location/play in the sport (Agel, Dompier, Dick & Marshal, 2007; Boyer et al., Pending review; Smith et al., 1997). In our study players were getting injured from similar types of plays and were not being penalized. The ambiguity surrounding legal versus clean plays causes tension among parents, referees, coaches and players about what constitutes a penalty, which ultimately compromises the overall safety of the sport.

The necessity for a graduated introduction to bodychecking hockey

Up until now attempts to reduce injury in youth hockey have met limited success. Efforts have largely focused on reducing injury through interventions directed towards coaches, players, and/or the overall playing environment. Cook, Cusimano, Tator and Chipman (2003) implemented the Think First injury prevention strategy for 11-12 year old hockey players and their coaches to reduce injury. The program involved showing players and coaches an educational injury prevention video for them to learn about mechanisms, consequences, and prevention of brain and spinal cord injury in ice hockey. While they did acknowledge some improvements in knowledge there was no evidence to suggest an overall

reduction in injury. Trudel, Bernard, Boileau and Marcotte (2000) examined the effects of an intervention strategy on bodychecking in youth hockey and concluded that:

> In spite of a favourable reception by the coaches, the proposed intervention strategy did not produce any modification, over a single season, of the behaviours of players when applying bodychecks. Nor were any effects demonstrated concerning the number of penalties taken and the number of injuries reported (p. 247)

Similarly, Lauer and Paiement (2009) implemented a program called 'The Playing Tough and Clean Hockey Program' to players 12 years and older in order to get players to play within the rules. The outcomes of the study indicated that the intervention did not reduce aggression, prompting the authors to say: "eliminating the undesirable behavior of aggression in hockey may be close to impossible… To eliminate unwanted behaviours such as aggression often the person is removed from the environment or the environment is changed" (p. 558). In terms of bodychecking hockey, the most obvious injury intervention strategy would likely be the removal of bodychecking at this level as this study and a host of others repeatedly report the increased risk of injury of bodychecking versus non-bodychecking hockey (Emery et al., 2010; Macpherson, et al., 2006; Regnier et al., 1989). This drastic approach has not been well received by Canadian hockey enthusiasts who 1) understand injury to be an unfortunate but natural part of the game; and 2) believe bodychecking to be the defining feature of Canadian hockey (Robidoux & Trudel, 2006). Some have tried to go head-to-head with these prevailing attitudes but have achieved little success (Cook et al., 2003; Lauer and Paiement, 2009; Marchie and Cuismano, 2003; Smith et al., 2000; Trudel et al., 2000). Keeping in mind that it is our contention that working within the existing structures of organized hockey is more likely to bring about desired

changes to the sport, the optimal intervention strategy (next to removing bodychecking altogether) would be to implement a regimented graduated system for introducing bodychecking to youth.

A graduated system would prevent youth from simply jumping from non-bodychecking to full bodychecking hockey without any real opportunity to develop skills to prepare to give and receive bodychecks. Although there were varying views on how to best protect players, most parents agreed that it is necessary to introduce bodychecking as a graduated system:

- [Coaches] taught the kids the right way but they rarely do what they are taught. I would like to see a graduated system where 'bodycontact' is introduced before full out 'bodychecking'. It is not an automatic reaction to properly perform bodychecking. There should be guidelines for introducing bodychecking in minor Peewee hockey. **(Fred and Ashley)**
- The kids are too young for bodychecking. I have a nephew on the Quebec side and their bodychecking is just as good as Ontario side at the bantam level. The growth of the kids levels-out at bantam (13-15 years of age). We should start introducing bodychecking in Peewee but more as training rather than full out. It should be delayed; there is too much difference in size, 13-15 year olds are more leveled off. **(Camilla)**
- I'm ok with bodycheking it if it's kept to what it's meant for. From all aspects, parents yelling 'hit him' 'take him out' has to remain true to the intent which is to gain puck position, remove the player from the puck. If you introduce it early kids will get used to it. Mike wouldn't be picked at Bantam [15-16 year olds]. They do

not do a good job at developing bodychecking in youth hockey. They should be doing more training on bodychecking. There needs to be processes to go with it. **(Christine)**

Parents are not the only ones calling for some type of graduated system. Todd McLellan, coach of the NHL's San Jose Sharks says that minor hockey is failing by not providing players with a graduated system to bodychecking (Wolfe, 2010). Popular TSN television hockey analyst Bob Mckenzie feels the same way stating that: "things like bodychecking, fighting and other elements of the pro game can be learned in an easier way later in life than the skills that go with how to skate, pass and shoot, so I think later is better" (Mckenzie, 2010).

Academics support the idea that a graduated system is necessary to safely introduce youth to bodychecking hockey. Sheldon and Aimar (2001) suggested that "a focus on skills such as skating, shooting, passing, and stick-handling, rather than on physical force and intimidation tactics, might be another way to reduce hockey aggression and the resulting injuries" (p. 308). Just as skills such as passing and shooting require training, Juhn et al. (2002) state that "the ability to avoid a check, take a check, and knowing which player to check in a given situation are all acquired skills that cannot be learned quickly. A developmental program that begins with bodycontact and progresses to full checking is therefore recommended" (p. 48). Some sort of policy or legislative change is therefore needed as Reid and Losek (1999) argue that eliminating or adjusting current bodychecking regulations could potentially reduce the number of significant injuries more than the enforcement of existing rules.

Here we see parents, coaches, the public and scholars uniting for the necessity of a graduated system for the introduction of bodychecking. However, for change to occur it is critical that all stakeholders get involved and that includes referees, policy and legislative makers. Kew (1987) states that for rules to change there needs to be "interaction between legislators, referees, players, and coaches" (p. 132). The legislators and referees are responsible for rule design and implementation whereas the players and coaches simply act within the given organizational structure. Currently, coaches and players are interpreting rules and for the most part are executing plays that are deemed legal, but in so doing there have been unanticipated, injurious outcomes. If the current rules and their interpretation are not protecting players from injury, a formal reassessment of the existing rules is necessary. We have emphasized here that in this study most injuries occurred from legal plays, in particular those that involved the combination of contact involving an opposing player and the boards. What needs to be reiterated is that players were not acting maliciously; rather they adjusted their playing styles to optimize self-preservation and on ice performance. Rule changes are therefore needed. In place already is a voluntary graduated system designed by Hockey Canada to best introduce bodychecking to youth hockey players. It is a four-step program that involves: Step 1, Positioning and Angling; Step 2, Stick Checks; Step 3, Bodycontact; Step 4, Bodychecking (Hockey Canada 2010b). It is not specified if this progression should occur over one season or multiple seasons, or when the initial steps should be introduced, but its aim to ensure players are not to be "hit, pushed or shoved into the boards" (Hockey Canada) seems a logical injury prevention strategy. The question remains, however, why such a program is not being enforced despite the plethora of research indicating the high risks associated with bodychecking hockey? What is certain is that if

policy makers and hockey practitioners wish to place youth safety first, action must be taken immediately. Beyond introducing bodychecking later in youth hockey, a formally introduced graduated system that prevents player contact along the boards would be the next best option.

Limitations

The major limiting factor from the study was not being able to interview the actual players themselves. Players were not interviewed as it proved difficult to find time before or after games as both the player and the parent were in a hurry to leave the rink. Parents were easier to interview as they waited before and after games in the arena lobby while the players were in the locker rooms putting on and removing their hockey equipment. Also, the only adults interviewed were parents and we did not get to assess the views of coaches, officials or other adults associated with the youth game.

Conclusion and Future Research

Popular opinion and previous literature shows hockey to be a highly violent and aggressive sport. However through the observations and analysis in this study, violence and aggression was relatively absent. By employing a mix-methods approach, utilizing injury enumeration and qualitative observations and interviews, perceptions of the overly aggressive and violent sport of youth hockey were dispelled. Observations and interviews with parents provided an enlightened vision of the misconstrued environment of youth hockey. By exposing the misconception that violence and aggression are responsible for the high injury rates in youth hockey, our research provides alternative readings. Players act

according to coach and parental instruction and are acting for the most part within the informal and formal rules of the sport. The majority of injuries that were documented occurred on legal plays that did not receive any type of penalty infraction. Moreover, parents stated explicitly that the children did not naturally accept bodychecking as part of hockey, but rather needed to be conditioned in order to give and receive physical contact. Of all fifteen boys' playing bodychecking hockey this year, 86% succumbed to injury and required some degree of comfort or trainer attention, with one of these particular players suffering 10 injuries himself. With this said, 22% of all injuries required the player to either the miss rest of the game or consecutive games miss games over the course of the season. With injury occurring so frequently, players need to develop strategies to cope with both inflicting and receiving injury. Instead of any formal training or rule changes to assist in protecting players, the basic coping mechanism parents, coaches and trainers provided centered on the naturalization of injury. In other words, instead of raising concern about injury, adults generally pointed to the inevitably of injury in hockey and encouraged players to learn to accept them if they wished to continue playing in the sport. In so doing, the magnitude of injury, especially injuries to the head which was our leading category of injury for severe injuries requiring a PGIA, was further accepted as part the game.

The Canadian public and those who run and organize hockey in this country are resilient to change. When one scrutinizes the game of hockey in Canada, it is seen as taking issue with the nation itself (Robidoux and Trudel, 2006). It is not the intention here to confront hockey practitioners, but instead to work with organizing bodies to seek strategies to best protect its participants. While there are various interpretations about how to remedy the issue of injury, one cannot ignore the overwhelming body of literature that identifies the

higher risk of injury associated with bodychecking hockey compared to non-body checking. If hockey policy makers and practitioners are adamant about continuing to introduce bodychecking at this level (at least in provinces like Ontario) there is a public obligation to re-evaluate the existing rule system to better protect players from injury. An important first step would be to simply formalize what Hockey Canada (2010b) has already informally introduced: the graduated process for the introduction of bodychecking. Players need to be taught the fundamentals of physicality in a step-by-step process and without gradually introducing players to bodychecking hockey, youth are being put unnecessarily at risk.

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[1] Pseudonyms have been provided to ensure participant anonymity.

CHAPTER VI: Conclusion

Concerns about safety in youth hockey have been openly expressed in public and academic circles, yet the prevalence of injury remains high at both the grassroots and elite levels of the sport. The comprehensive mix-method approach utilized in this study proved most effective in understanding not only injury frequencies, but how and why they were taking place. With hockey being such a fast paced game, it is difficult to observe and document injury effectively. The use of our dual video camera system proved to be invaluable as it allowed us to break down injuries and discover what exactly led to injury through slow motion analysis. The multi-method approach enabled a review of the observation grids and PGIA assessments to ensure accuracy in reporting. This layered approach enabled better documentation of the amount of injuries, the types of injuries and what were the contributing factors to injury.

Such methods have led us to determine that bodychecking hockey at the Peewee level has a significantly higher rate of injury than non-bodychecking hockey. The combined contact of player and boards was the leading mechanisms of injury, which up until now has not been properly identified in previous research. Of all injuries requiring the player to miss at least a period away from play, the head was injured more often than any other body part. Further the most frequent type of injuries was diagnosed as strains and/or whiplashes. We have identified how issues of balance, coordination and timing impact both the delivery and reception of bodychecks making youth at this level particularly vulnerable. Through the successful execution of bodychecking hockey, players inevitably put themselves and their opponents at risk.

Of all fifteen boys playing bodychecking hockey this year, 86% succumbed to injury and required some degree of comfort or trainer attention with one of these players alone suffering 10 injuries himself. With this said, 22% of all injuries required the player to either miss the rest of the game or a number of games over the course of the season. With injury occurring so frequently players needed to develop strategies to cope with both inflicting and receiving injury. Instead of any formal training or rule changes to assist in protecting players, parents, coaches and trainers made their best attempts at aiding their children and players to cope with injury. In other words, instead of raising concern about injury, adults generally pointed to the inevitably of injury in hockey and encouraged players to learn to accept them if they wished to continue playing in the sport.

Popular opinion and previous literature have shown hockey to be a highly violent and aggressive sport. However, the current analysis of youth hockey did not live up to these assumptions. Observations and interviews provided an enlightened vision of the misconstrued environment of youth hockey. By breaking down the misconception that violence and aggression were responsible for the high injury rates in youth hockey, our research provides alternative readings. Players act according to coach and parental instruction and are, for the most part, conducting themselves within the informal and formal rules of the sport. The majority of injuries that were documented occurred on legal plays that did not receive any type of penalty infraction. Moreover, parents stated explicitly that the children did not naturally accept bodychecking as part of hockey, but rather needed to be conditioned in order to give and receive physical contact.

Finally, this study provided insight about minor hockey attitudes toward injury and how traditional hockey perspectives contribute and construct a risky environment. From my

personal experience playing minor and later Junior hockey, I learned that sacrificing for the team, playing rough and physical, standing up for teammates are all valued qualities that coaches reward through greater playing time and advancement into the elite levels of the sport. By playing a physical brand of hockey you can thus make up for imperfect playing ability and compete with more skilled players. At a more symbolic level, the aggressive and often violent nature of the sport has been tolerated in Canada (Robidoux 2002; Robidoux & Trudel, 2006). These ideals are being perpetuated at the younger age levels. As a result, pain and injury have been adopted and normalized to the extent that seeking ways to reduce injury are interpreted as misguided and a slight on the 'Canadian game'. It is time that Canadian hockey makes a change at its grass roots levels in order to safely introduce Canadian hockey's most valued skill, bodychecking. The intention of this work is not to remove bodychecking from Canadian culture and change the way the game is played. Rather, with the significant body of literature pointing to bodychecking putting youth at risk, and with the current study confirming this, something needs to be done. We have shown that the aggression and violence does not, for the most part, cause injury or create an injurious environment. Rather, the rules and the way in which the game is structured compromise the safety of youth players playing bodychecking hockey. To properly offer youth a process to apply the skill of bodychecking, policy makers should implement a step-by-step graduated system to bodychecking. Offering bodychecking clinics a few times over the course of a season is not a realistic solution. Rather each step (angling, stick checking, bodycontact and bodychecking) should take a season to implement. Allowing youth to play with bodycontact, which is no contact associated with the boards, will allow youth to negotiate

bodychecking without the complications of board contact. Further, it will give youth the necessary grounding in the fundamentals of physical play, which currently, is not happening.

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APPENDICIES

APPENDIX A: Observation Grid

2009-2010 Injury Study Observation Grid

Team Name:
Game Number:_____
Player Name:_____
Date:_____

Appendix 1: Observation Grid

	Injury severity using first aid criteria: (1) Slight injury: Need comforting; (2) Medium injury: First aid, minor injury; (3) Severe injury: First aid, major injury; (4) Very severe injury: Medical attention needed	**Injury severity in terms of time missed:** (1) Missed shift; (2) Missed period; (3) Missed game; (4) Missed games	**Transgressional actions leading to injury:** (1) Instrumental transgressional; (2) Instrumental non-transgressional	**Enumerating causation/mechanisms of injury:** (1) Contact with player; (2) Contact with stick; (3) Contact with puck; (4) Contact with ice; (5) Contact with boards
Upper body injury				
Lower body injury				

APPENDIX B: Post-Game Injury Assessment

Post-Game Injury Assessment

Injury definition:

Any player who, as result of unwanted physical trauma, misses at least one period away from game play qualifies for the implementation of the Post-Game Injury Assessment (PGIA). The PGIA is to be completed at the completion of the game in which a player was tended to by the team trainer. It is the team trainer's responsibility to complete the PGIA and submit it to the researcher group within one game of the sustained injury.

Date:_____(m/d/y)

Team Name:_____

Game Number:_____

Player Name:_____

Age:_____(m/d/y)

Height:_____(inches)

Weight:_____(lbs)

1. What was score of game at time of injury:_____
2. At what place did this injury occur?
    a. Home
    b. Away
    c. Neutral site
    d. Other:_____
3. Injury occurred during:
    a. First period
    b. Second period
    c. Third period
    d. Other:_____
4. Injury is a:
    a. New injury
    b. Recurrence of injury from this season
    c. Recurrence of injury from previous season (Hockey)
    d. Recurrence of other sport injury and what sport:_____
    e. Recurrence of non-sport injury

5. The injury involved:
    a. Collision with other player
    b. Collision with boards
    c. Collision with ice
    d. Contact with stick or puck
    e. Bodycheck given
    f. Bodycheck received
    g. No apparent collision or contact (other):_____

6. The injury involved:
    a. Skating with head down/unaware of surroundings
    b. Retrieving puck from dump in
    c. Puck side offensive/defensive and winger/defensemen confrontation
    d. Cutting into middle of ice
    e. Top of crease confrontation

7. Was there a penalty involved in the play that caused the injury?
    a. Yes, what penalty:_____
    b. No

8. Was the injury:
    a. Musculoskeletal or specific body part injured
        i. Knee
        ii. Thigh groin
        iii. Shoulder
        iv. Hip
        v. Arm/elbow
        vi. Head
        vii. Spine
        viii. Chest/rib
        ix. Fingers
        x. Chin
        xi. Wrist

    b. Less specific

        i. Contusion, where:_____
        ii. Sprain, where:_____
        iii. Strain, where:_____
        iv. Laceration, where:_____
        v. Fracture, where:_____
        vi. Dislocation, where:_____
        vii. Concussion, how severe:_____

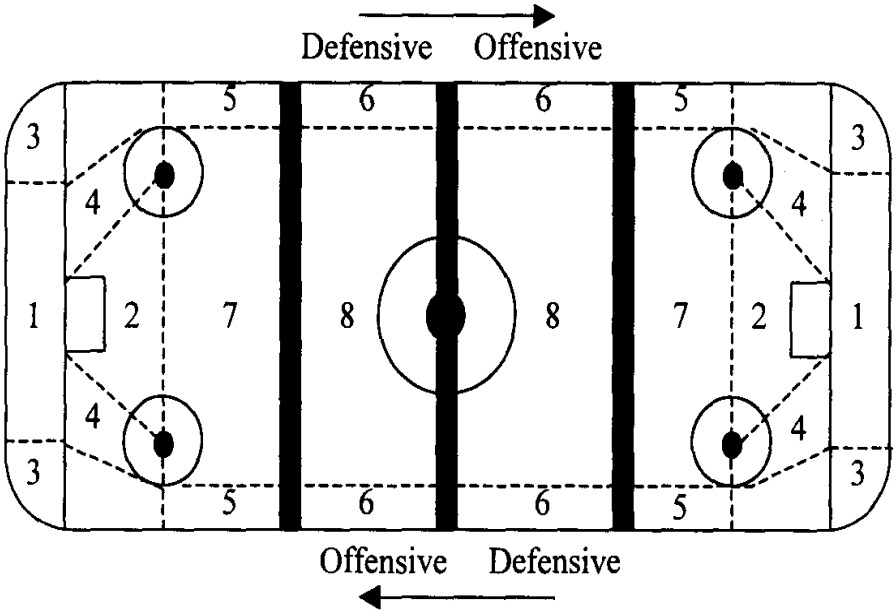
9. Position played at time of injury

    a. Center
    b. Left-wing
    c. Right-wing
    d. Left Defense
    e. Right Defense
    f. Goalie

10. Was the injury:

    a. Instrumental transgressional
    b. Instrumental non-transgressional

11. Which area best represents where the injury occurred:



(Gilbert & Trudel, 2000, p. 295)

APPENDIX C: Semi-Structured Interview Guide

Ontario Male Youth Hockey
Semi Structured Interview Guide

1) How would you describe your child's experiences playing hockey this year?

2) How would you describe their experiences this year compared to last year in non-body checking hockey?

3) Are there any concerns you have as a parent watching your child play hockey?

4) What do you think about body checking in youth hockey?

5) Do you feel the kids are executing body checking appropriately?

6) Has your child even been hurt playing hockey? What was the circumstance?

7) If so, has it affected your child's involvement in anyway?

8) Do you think hockey can be made more safe?

APPENDIX D: Informed Consent for Parents (English and French)

Université d'Ottawa · University of Ottawa
Faculté des sciences de la santé
École des sciences de l'activité physique
Faculty of Health Sciences
School of Human Kinetics

INFORMED CONSENT

TITLE OF THE STUDY:

Comparative Study of Injury in Youth Competitive Hockey in Quebec and Ontario

INVESTIGATORS:

Dr. Michael Robidoux, Associate Professor, School of Human Kinetics (SHK), University of Ottawa
Marshall Kendall, Ph.D. Candidate, SHK, uOttawa
Charles Boyer, M.A. Candidate, SHK, uOttawa
Stephen Adams, Ph.D. Candidate, SHK, uOttawa
Hassan Saeed, Honours Student, SHK, uOttawa

COMMUNITY PARTNERS:
Hockey Canada, Ottawa District Minor Hockey Association, Association du Hockey Mineur de Hull, Ottawa Girls Hockey Association.

PURPOSE OF THE RESEARCH

Document injury in youth ice-hockey bodychecking and non-bodychecking leagues in Ontario and Quebec. The research involves game observations to enumerate injuries as they occur in playing situations. In addition to quantifying the amount of injuries, this research will provide contextual details about injury situations to better understand how and why injuries are occurring.

PARTICIPATION IN THE STUDY

This study is primarily an observational study where researchers will observe and record on ice play of league hockey games. Participation in the study involves participating in an injury report system to help monitor injury during the games. Injury reporting would consist of players self-reporting any injury incurred during games and answer a brief list of questions pertaining to the injury. Players who have not come forward but who were identified as being involved in an injurious situation may also be approached and be asked to answer questions pertaining to the situation observed during the game by researchers. The post-game injury assessment will take about 5 minutes.

It is important to note that video recordings of the games will be stored in locked filing cabinets in Dr. Robidoux's office at the University of Ottawa for a period of 10 years. The recordings will only be accessible to the members of the research team. Recordings will be destroyed after 10 years.

BENEFITS

The primary benefit of this study is that at the conclusion of the study we will be presenting the findings to our hockey partners; Hockey Canada, Association du Hockey Mineur de Hull, Ottawa District Minor Hockey Association and the Ottawa Girls Hockey Association, to help reduce the prevalence and severity of injury in youth hockey.

CONFIDENTIALITY AND ANONYMITY

All participants will remain anonymous. Research participants will be categorized by a number with only Researchers and Research Assistants knowing what number corresponds to whom. All video documentation will be altered via digital editing software to avoid identification. If a participant withdraws the interview data will be destroyed immediately and will not be used.

VOLUNTARY PARTICIPATION

Participation in this study is entirely voluntary and participants can withdraw from the study at any time and/or refuse to answer any questions, without suffering any negative consequences.

RIGHTS OF THE PARTICIPANTS

The researchers guarantee that:

- Participants can withdraw from the project at any time.
- The confidentiality of the information gathered as well as the anonymity of all participants will be rigorously protected as indicated above.

COMMUNICATION OF RESULTS

At the conclusion of the study research results will be presented via a written plain language summary and oral presentation to the study partners, Hockey Canada, Association du Hockey Mineur de Hull, Ottawa District Minor Hockey Association and the Ottawa Girls Hockey Association.

There are two copies of the consent form, one of which you may keep.

CONSENT:

I the undersigned, agree to participate in the above research study. The study has been explained to me, I have had the opportunity to ask questions about my child's involvement and to receive additional details that I wanted to know about the study. I understand that by accepting to participate, I am in no way waiving my right to withdraw from the study at any time.
I have been given a copy of this form.

Parent/Legal Guardian's signature: _____ Date: _____

Signature of Researcher: _____ Date: _____

Université d'Ottawa · University of Ottawa

Faculté des sciences de la santé
École des sciences de l'activité physique

Faculty of Health Sciences
School of Human Kinetics

FORMULAIRE DE CONSENTEMENT

TITRE DU PROJET:

Étude comparative sur les blessures dans le hockey de compétition pour les jeunes au Québec et en Ontario.

CHERCHEURS:

Michael Robidoux, Ph.D., professeur agrégé, École des sciences de l'activité physique (ÉSAP), Université d'Ottawa
Marshall Kendall, étudiant au doctorat, ÉSAP, uOttawa
Charles Boyer, étudiant à la maîtrise, ÉSAP, uOttawa
Stephen Adams, étudiant au doctorat, ÉSAP, uOttawa
Hassan Saeed, étudiant au baccalauréat, ÉSAP, uOttawa

PARTENAIRES COMMUNAUTAIRES:

Hockey Canada, *Ottawa District Minor Hockey Association,* Association du hockey mineur de Hull, *Ottawa Girls Hockey Association.*

BUT DE LA RECHERCHE

Documenter les cas de blessures dans les ligues de hockey sur glace pour les jeunes avec et sans contact en Ontario et au Québec. Cette recherche implique des observations de parties de hockey de manière à recenser les blessures à mesure qu'elles se produisent en situations de jeu. En plus de quantifier le nombre de blessures, cette recherche fournira des détails contextuels sur les situations où les blessures se sont produites de manière à mieux comprendre comment et pourquoi les blessures surviennent.

PARTICIPATION À L'ÉTUDE

Cette étude est avant basée sur l'observation en ce que les chercheurs assisteront à des parties de ligues de hockey et enregistreront des données sur les situations de jeu. La participation à l'étude implique de contribuer à un système de déclaration des blessures qui vise à enregistrer des données sur les blessures survenues au cours de la partie. La déclaration de blessures se fait par le biais des joueurs, qui rapportent eux-mêmes toute blessure survenue au cours d'une partie et répondent à quelques questions sur cette blessure. Les joueurs qui ont été identifiés comme impliqués dans une situation de blessure, mais qui ne l'ont pas rapporté, pourraient être approchés pour qu'ils répondent à des questions sur la situation observée par les chercheurs. Les entrevues de déclaration des blessures prendront environ 5 minutes à compléter.

Il est important de noter que des enregistrements vidéos des parties seront conservés dans des filières verrouillées dans le bureau du Professeur Robidoux à l'Université d'Ottawa pour une période de dix (10) ans. Les enregistrements seront seulement accessibles aux membres de l'équipe de recherche. Les enregistrements seront détruits au bout de cette période de dix ans.

AVANTAGES

L'avantage premier de cette étude est que, lorsqu'elle sera terminée, ses résultats seront présentés aux partenaires de l'étude, soit Hockey Canada, l'Ottawa *District Minor Hockey Association*, l'Association du hockey mineur de Hull et l'Ottawa *Girls Hockey Association*, le tout dans le but d'aider à réduire la prévalence et la sévérité des blessures dans le hockey pour les jeunes.

CONFIDENTIALITÉ ET ANONYMAT

L'anonymat est garanti pour tous les participants. Les participants seront identifiés par un numéro, les correspondances aux noms des participants étant connues des chercheurs et des assistants de recherche seulement. Toute la documentation vidéo sera altérée à l'aide d'un logiciel spécialisé afin d'éviter que les participants puissent être identifiés.

PARTICIPATION VOLONTAIRE

La participation à cette étude est entièrement volontaire et les participants peuvent soit se retirer de l'étude, soit refuser de répondre à toute question à tout moment et ce, sans possibilité de conséquences négatives.

DROITS DES PARTICIPANTS

Les chercheurs garantissent que:

- les participants peuvent se retirer de l'étude en tout temps;
- la confidentialité des informations recueillies et l'anonymat de tous les participants seront rigoureusement protégés et ce, de la manière indiquée plus haut.

COMMUNICATION DES RÉSULTATS

À la fin de l'étude, les résultats seront présentés sous la forme d'un sommaire en langage courant et d'une présentation orale aux partenaires de l'étude, soit Hockey Canada, l'*Ottawa District Minor Hockey Association*, l'Association du hockey mineur de Hull et l'*Ottawa Girls Hockey Association.*

Il existe deux copies du formulaire de consentement, dont une que vous pouvez conserver.

CONSENTEMENT

Je, soussigné, consens à participer au projet de recherche décrit plus haut. L'étude m'a été expliquée et j'ai eu l'occasion de poser des questions sur mon implication. J'ai également reçu de l'information sur tout détail supplémentaire que j'ai voulu connaître à propos de l'étude. Je comprends que le fait de consentir à participer à la présente étude ne me prive pas de mon droit de me retirer de l'étude en tout temps.

J'ai reçu une copie de ce formulaire.

Signature du parent/ gardien: _____ Date: _____

Signature du chercheur: _____ Date: _____

Nota: L'utilisation du masculin sert uniquement à alléger le texte et désigne autant les hommes que les femmes.

FIGURES

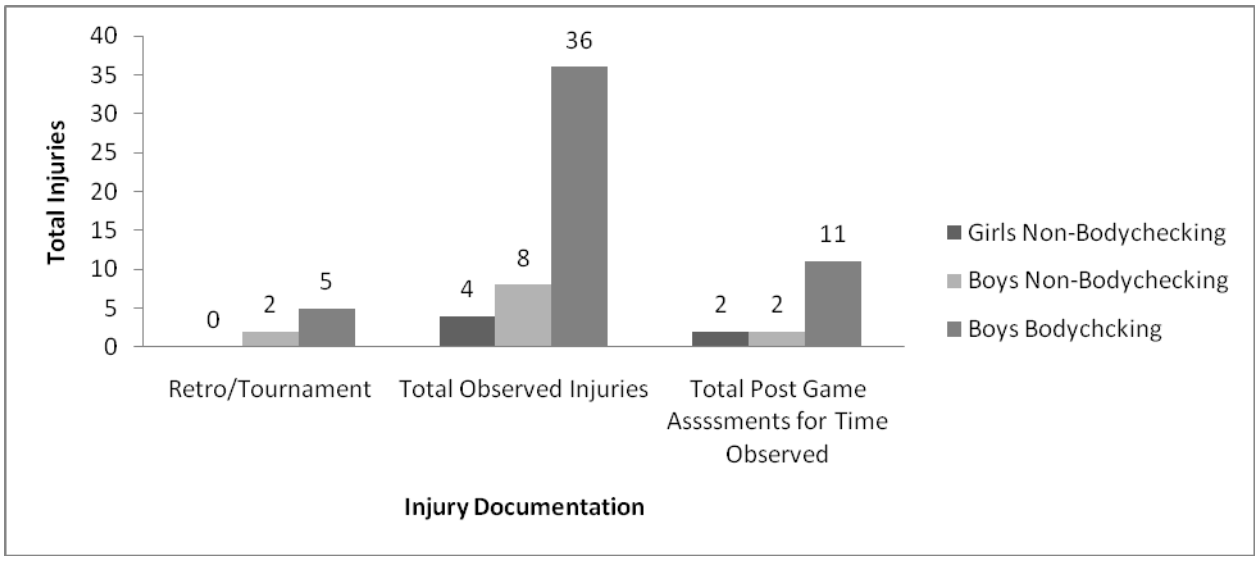


Figure 1: Breakdown of injury.

Breakdown of injury to show all reporting methods: Retro, observed and PGIA injuries. Injuries were compared between boys' bodychecking, boys' non-bodychecking and girls non-bodychecking.

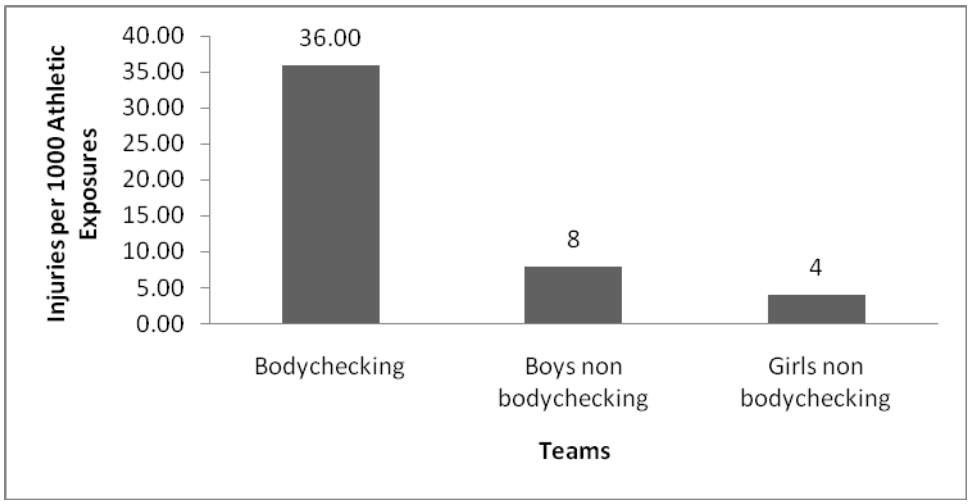


Figure 2: Injuries represented over 1000 athletic exposures.

Total injuries documented from boys bodychecking, boys non-bodychecking and girls non-bodychecking and represented over 1000 total Athletic Exposures to offer comparison between groups.

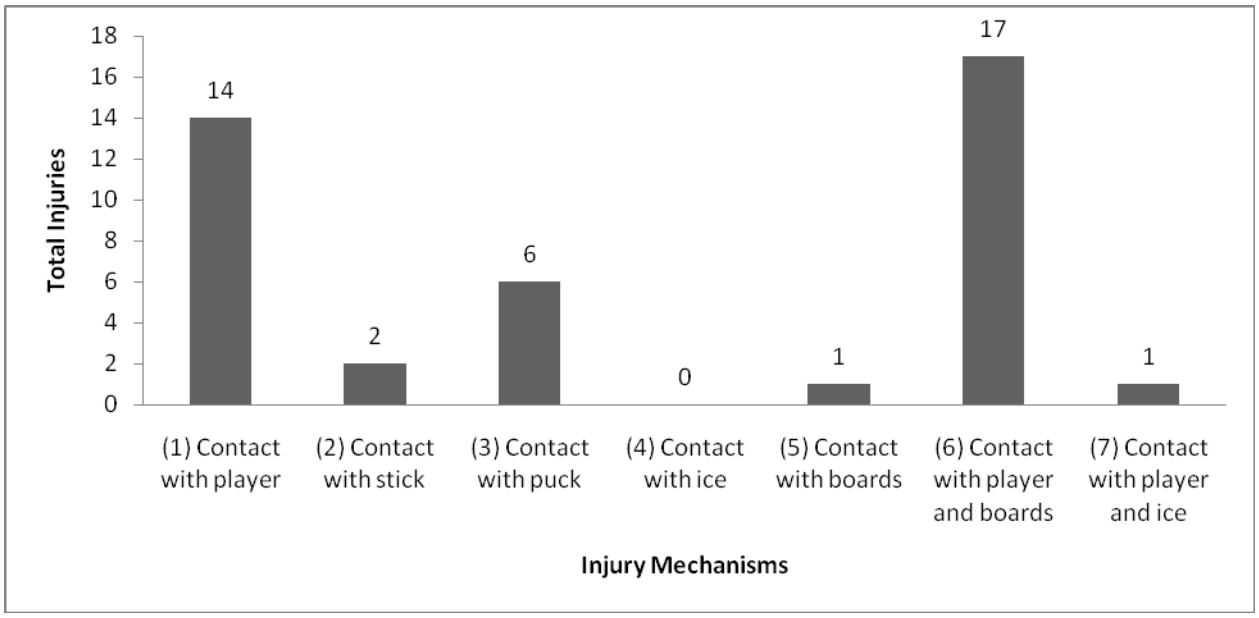


Figure 3: Mechanisms of injury.

Mechanisms of injury for all injuries sustained to boys bodychecking hockey.

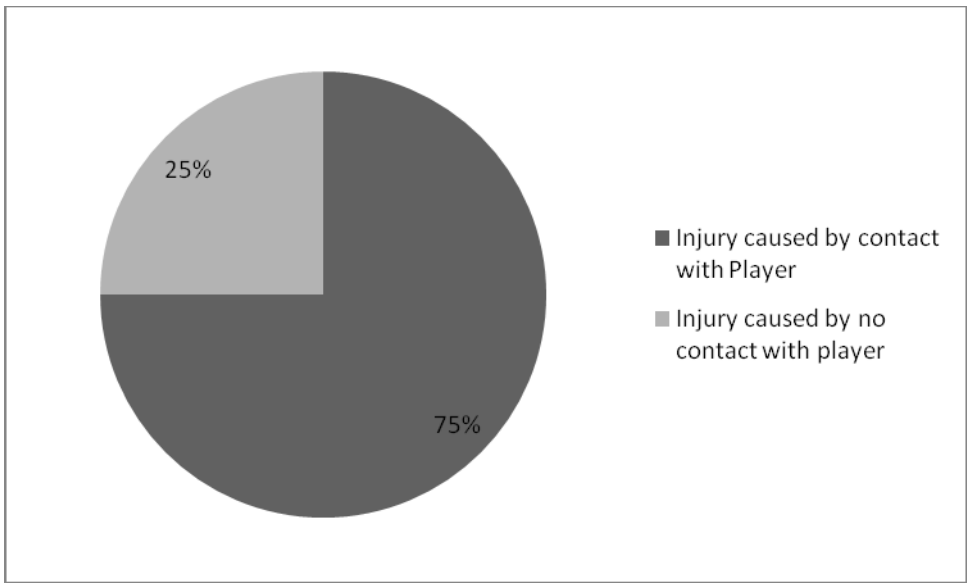


Figure 4: Contact related injuries.

Player contact vs. no player contact causing all injuries to boys bodychecking hockey

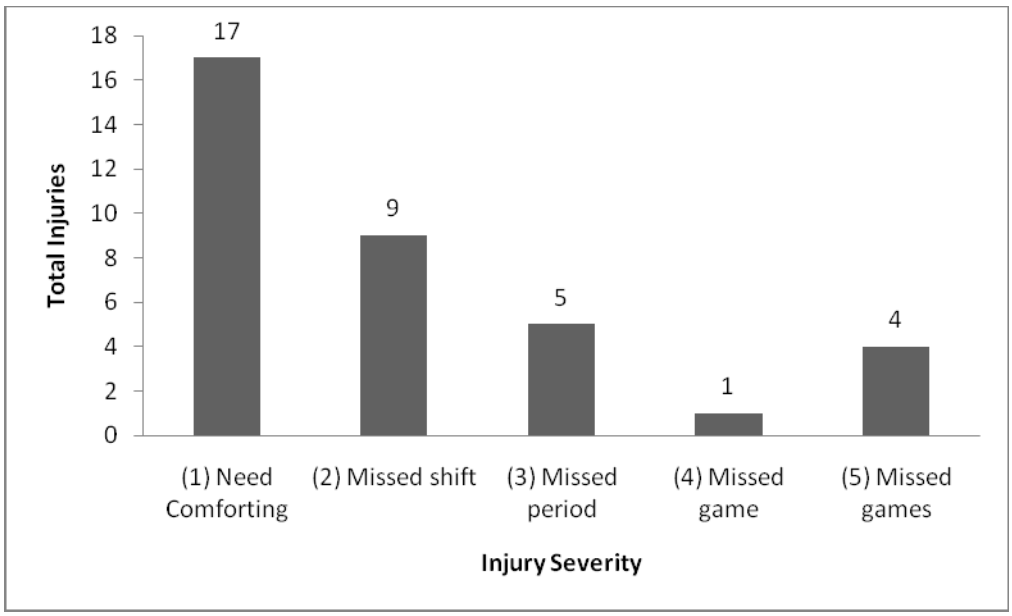


Figure 5: Injury severity

Injury severity for all injuries sustained to boys bodychecking hockey.

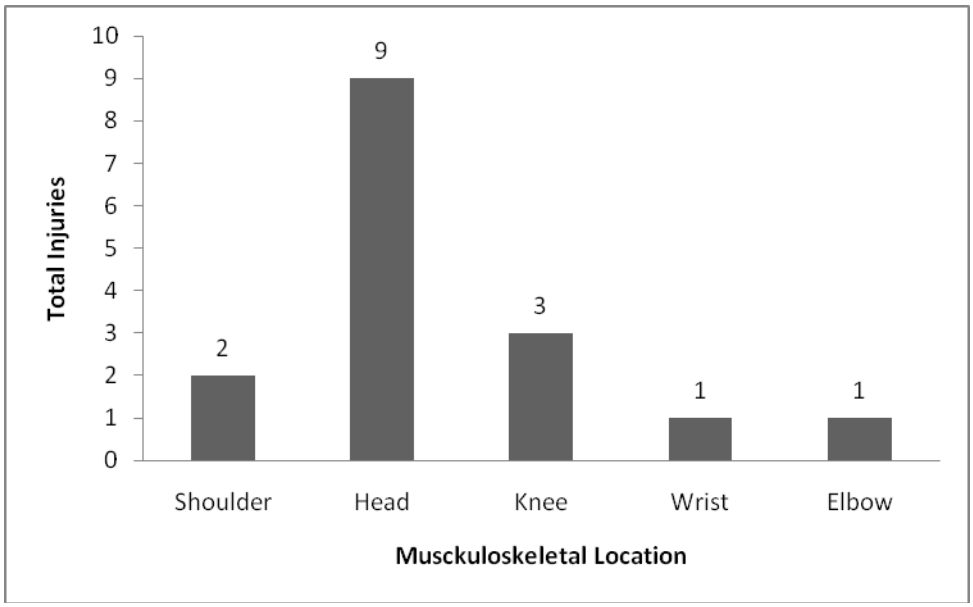


Figure 6: Musculoskeletal locations of injury.

Musculoskeletal locations of injury for severe injury requiring a PGIA in boys bodychecking hockey.

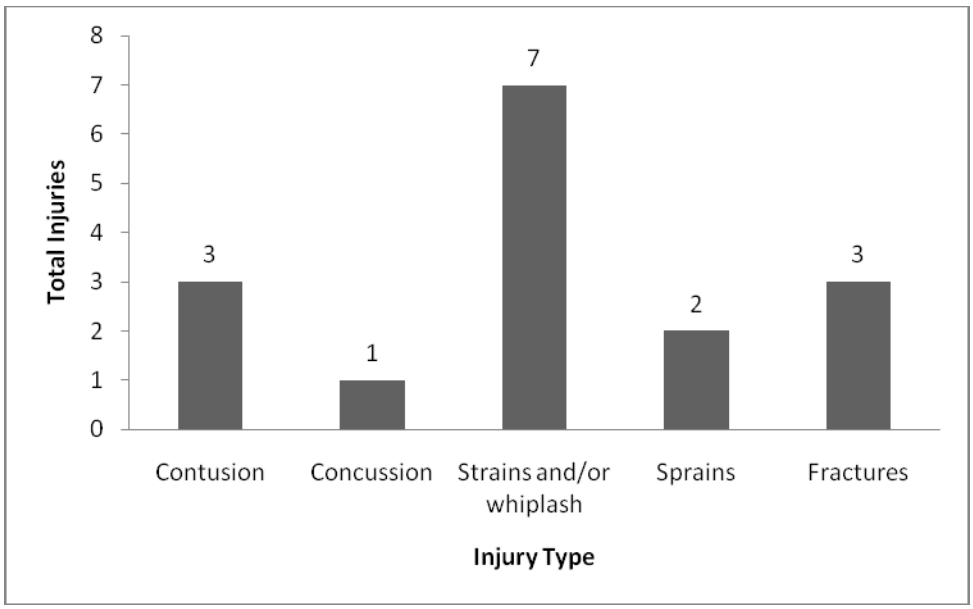


Figure 7: Characteristics of injury.

Characteristics of injury for severe injury requiring a PGIA in boys' bodychecking hockey.

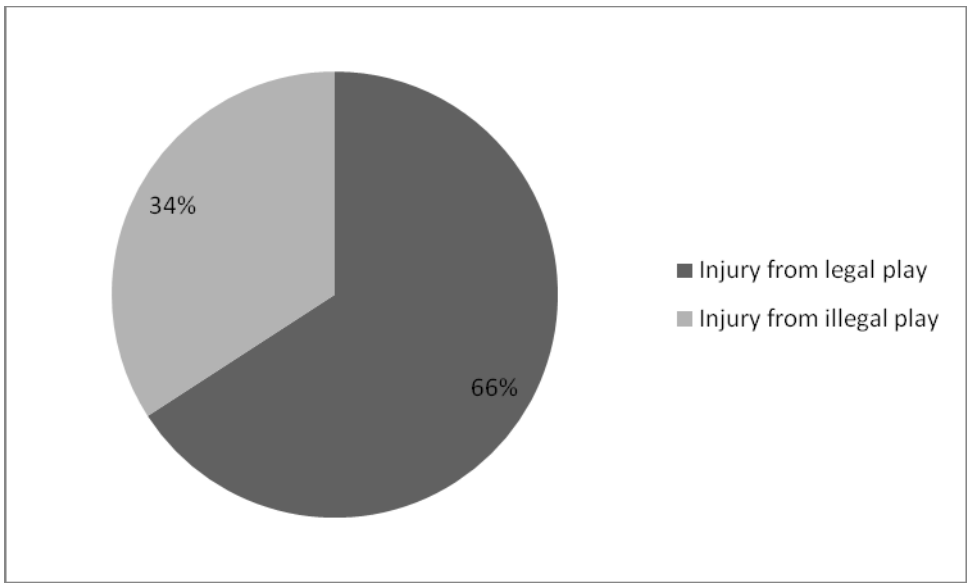


Figure 8: Legal vs. illegal play.

Legal vs. illegal play causing injury in boys' bodychecking hockey.

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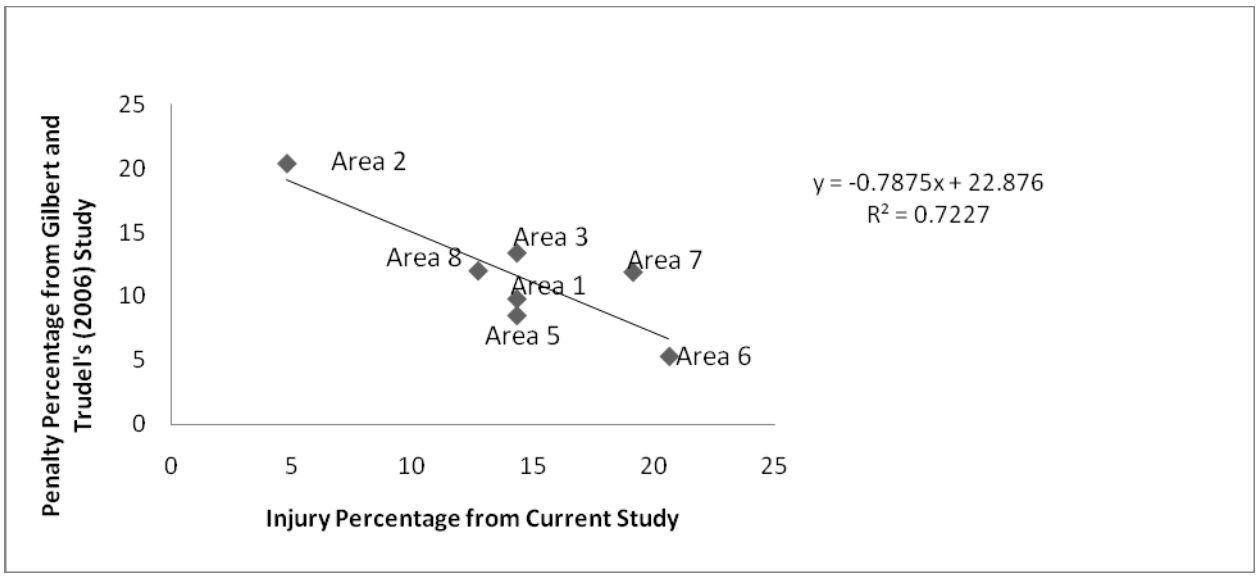

Figure 9: Injury ice locations.

Injury location from boys' bodychecking hockey vs. penalty locations from Gilbert and Trudel's (2000) study. Area 4 was deleted as this area contained no injuries.