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Exploring Minor Hockey Players' Knowledge About and Attitudes Toward Concussion: Implications for Prevention

by

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Dedications

This thesis is first and foremost dedicated to my family. Without their unwavering and unconditional support, compassion, and encouragement my journey through graduate school would not have been possible. I recognize and immensely appreciate the sacrifices you all have made so that I could pursue my dreams. My loving sister Allie, you have supported me in more ways than you'll ever know. You've been the best roommate and 'landlord' and have given so much of yourself without hesitation. My Beagle, Abby, has brought me such joy and needed pet therapy during stressful periods, and has reminding me to literally stop and smell the flowers along the way and to make time to play.

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Furthermore, my research is also dedicated to those injured in sports or other circumstances. Through my own prolonged injury recovery I can appreciate the challenges of trying to meet daily life requirements and do what you love despite pain or disruptive symptoms.

This thesis is five chapters of research, but more than that it signifies one chapter of my life coming to a close and the opening of all the opportunities I will have to give back and to continue to develop professionally and personally.

Abstract

Concussions in ice hockey are a serious public health concern, however too many athletes fail to recognize or report their symptoms. A survey was developed to assess minor hockey players' concussion knowledge, attitudes, and reporting behaviour, as little is known from their perspective. Male and female Pee Wee, Bantam, and Midget level players (n = 183) and a comparison group of non-hockey players (n = 37) completed the questionnaire. Players had foundational knowledge about concussions, however over half underestimated the prevalence and over 30% were unaware of return to play (RTP) protocols. Although nearly all players knew what they "should" do when concussed, 18% did not follow recommendations. Players reported more concern and appreciation of the seriousness of concussion compared to non-players, but they tended to minimize their vulnerability. The most common and helpful information sources were parents, doctors, and coaches, therefore knowledge translation efforts should target theses audiences.

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Chapter one - Introduction

Mild traumatic brain injury (MTBI) is a topic that has stimulated a substantial amount of clinical and research interest in recent years. The World Health Organization's (WHO) Collaborative Task Force on MTBI reports a high population incidence rate of MTBI at above 600/100,000 population per year (Cassidy et al., 2004). MTBI accounts for approximately 70-90% of treated traumatic brain injury events (Cassidy et al., 2004) and represents a serious public health concern due to accompanying morbidity and even tragic cases of mortality (Echlin, 2010; Wiebe, Comstock, & Nance, 2011).

Concussion is considered a subset of MTBI, which is caused by direct physical impact to the head or from indirect forces exerted on the brain causing it to move within the skull (Wiebe et al., 2011). Even subtle injury to the brain can disrupt the normal functioning and elicit an array of physical, cognitive, sensory, and emotional symptoms (Coghlin, Myles, & Howitt, 2009; Wiebe et al., 2011). Furthermore, once injured the brain may be more likely to become re-injured (Cusimano, Chipman, Volpe, & Donnelly, 2009). These consequences can severely disrupt an individual's activities, lead to prolonged health problems, and can be cumulative in nature with repeated concussions (Collins, et al., 2002; Guskiewicz et al., 2003).

Children and adolescents are at a particularly high risk for sustaining concussions. In fact, concussions represent the most common cause for hospitalization of young people with 25% of cases related to sports injury (Anstey et al., 2004; Browne & Lam, 2006). Recent research suggests that children have

different physiological responses than older adolescents or adults with MTBI and can experience more cognitive disruption which can have a secondary negative impact on their educational and social attainment (McCrory, Collie, Anderson, & Davis, 2004).

Concussions are one of the most commonly occurring athletic injuries in contact sports (Coghlin et al., 2009). In Canada, ice-hockey accounts for a large portion of sport-concussions (Cusimano et al., 2009; Echlin, 2010). A recent study found that the risk of concussion for children between the ages of 6 to 16 was 6 times greater for organized sport than recreational activities (Browne & Lam, 2006) and pediatric athletes (under 19) account for the majority of organized and contact sport participants (Buzzini & Guskiewicz, 2006). With over 550, 000 participants in minor hockey across Canada the potential for concussion injuries in young athletes is concerning (Coghlin et al., 2009).

The Problem at Hand

Wiebe et al. (2011) have outlined barriers to optimal care for concussion. These include a lack of awareness that a concussion has occurred (by the patient, parent, coach, or clinician), and lack of appreciation of the clinical importance of the issue (i.e. the long-term consequences) (p. 69). For these reasons there is a problem with the identification and reporting of concussions.

Altering the perspectives and behaviours of sports participants is not an easy task considering sports ethics norms and the unique performance pressures faced by athletes. One challenge is the prominent "macho ideal" in sports, which encourages athletes to play through pain or to "shake it off" if they experience an

injury such as a concussion (Young, White, & McTeer, 1994). Fear of being benched or sheer motivation to win or advance can lead players to mask or deny injury symptoms (Cusimano et al., 2009; McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004). This places athletes at a much greater risk for re-injury and/or exacerbation of their symptoms if they return to play before recover is complete (Cohen, Gioia, Atabaki, & Teach, 2009). Echlin (2010) notes that widespread education is required in order to bring about culture change regarding concussion.

Misunderstandings regarding the causes, symptoms, and sequelae of MTBI have been well cited in the literature. Trends reveal that coaches, parents, and players demonstrate greater general knowledge compared to the lay population (Mulhern & McMillan, 2006). Recent research indicates that athletes and coaching staff are beginning to hold fewer misconceptions about MTBI than previously reported (Guilmette, Malia, & McQuiggan, 2007), however serious deficits in knowledge continue to exist and sports concussions continue to occur with high and perhaps even increasing frequency (Cusimano et al., 2009). The danger inherent with misconceptions and lack of knowledge is the potential for worsened consequences if a concussion is not recognized, reported, and treated appropriately (Cohen et al., 2009).

Rationale

The majority of research regarding knowledge and concussion symptom reporting has focused on college and adult athlete samples; however, there is a dearth of information from the perspectives of young players (Carroll et al. 2004). The decreased likelihood that young athletes have access to sports medicine

resources and professionals at sporting events heightens the risk for under recognition of concussions in this population, thus researchers argue that there is greater reliance on pediatric athlete self-report of symptoms than for adults (Cohen et al., 2009; Meehan, Taylor, & Proctor, 2011).

Initial studies that surveyed college athletes suggested that these individuals are often not aware of the problems that could occur as a result of a concussion (Kaut, DePompei, Kerr, & Congeni, 2003). College level athletes have had many years of experience functioning in sporting environments and have greater exposure to knowledge and education about injuries compared to younger athletes. Thus, if college athletes presented with gaps in their knowledge and understanding, the concern is that young populations would be at greater risk of making poorly informed decisions. To date, very few studies have explored the issue of what sources of information influence young athletes' knowledge of concussions and who would be most likely to influence their knowledge level.

There have been many advances in what is known about concussions and their consequences in the literature. However, knowledge gaps and the continued problems of concussion under reporting and recognition are evidence that important information is not reaching target populations or having the desired influence on attitudes and behaviours (Woolf, 2008). This signifies that efforts are needed to improve the knowledge translation process. Knowledge translation is essentially about effectively transferring the right information or message to the target audience in the most appropriate way so that they can apply this knowledge to their decision making (Provvidenza & Johnston, 2009). In order to enhance

athlete concussion recognition and reporting, several audiences and stakeholders must be targeted in order for knowledge translation to be effective (Straus, Tetroe, & Graham, 2009). Prior to the dissemination of information, the primary research findings must be synthesized and converted to the most understandable and relevant format for the audience.

Primary research findings on sports concussions in hockey, for example, are synthesized into best practice guidelines on how to assess, manage, and treat concussions. Interactive education sessions are effective ways to disseminate information to physicians, in addition to online injury prevention sources and print materials (Provvidenza & Johnston, 2009). Similar strategies in conjunction with peer discussion and reflective practices can transfer meaningful knowledge to coaches. Coaches and physicians are key for transmitting this information to parents and athletes. Materials such as information sheets that convey messages pertinent to parent and player can assist parents and coaches with this process. Overall, through the current exploration of minor hockey players' knowledge acquisition, views on concussion, and their safety practices it is hoped that this study will inform the process of transferring concussion safety messages to athletes.

Underlying Assumptions

Certain assumptions underlie the formation of research questions for this study. A primary assumption is that knowledge and attitudes are relevant to concussion injury behaviour. Research currently identifies that athletes have limited awareness of the symptoms and potential significance of a concussion and

are likely to hold distorted perceptions that minimize the potential severity of outcomes associated with concussions. Thus, these variables are important to explore and understand (Wiebe et al. 2011) in youth sports and serve as a primary goal of this study.

Second is the assumption that increasing knowledge and shifting attitudes leads to safer practices. Specifically increasing an athletes' understanding of concussions and appreciation for the severity of, and personal vulnerability toward the injury will lead to preventative behaviours such as symptom recognition and reporting of injury to appropriate sources. Education has been cited by many researchers as an important factor contributing to behaviour change (McLaughlin & Glang, 2010), and improving the quality of education has been found to be correlated with improved safety practices (Morrongiello et al., 2008). Some researchers have found that knowledge may indirectly lead to positive attitudes toward safe practices, which appears to be more predictive of behaviour change (Morrongiello et al., 2008). Therefore, evaluating both of these factors is relevant and important to this study.

It is assumed that the children in this sample will have access to roughly the same means of information. Due to the homogeneous nature of the sample chosen (competitive minor hockey players) it is expected that the participants will have similar access to information through school and their sporting team. It is also expected that there will be limited diversity in socioeconomic status due to the high cost associated with playing competitive hockey, therefore access to media sources within the home are likely to be similar.

The Present Study

The purpose of the study is two-fold; 1) to explore minor hockey athletes' knowledge about and their attitudes/ beliefs toward sports-concussions, and 2) to identify where young hockey players are getting their information about concussions and what sources have been the most helpful. A description of current knowledge levels and sources, attitudes toward concussion, and symptom reporting practices will be acquired by administering surveys to a sample of minor hockey players. Player results will also be compared to those of a non-player sample.

A review of literature regarding the recognition and management of sports concussions and implications with pediatric populations will follow in Chapter Two. Trends in research regarding knowledge about and attitudes toward concussion, as well as athlete symptom reporting behaviours will be presented. The review will conclude with current views on prevention and education of this injury. Details regarding the methods of data collection (Chapter Three) and quantitative statistical analysis of the data will then be presented (Chapter Four). Finally the results will be analyzed (Chapter Five) and the document will conclude with a discussion of the limitations of the present study and future implications.

Chapter Two – Literature Review

This chapter will provide an overview of the definition of concussion, the symptoms and brief guidelines of assessment and management, the incidence, and specific considerations for children and for hockey players. The following is a review of the literature on concussion knowledge, sources of this knowledge, attitudes, and symptom reporting behaviour practices among athletes. The final section of the literature review will explore current concussion education and prevention programs in Canada and how to effectively educate adolescents. The rationale leading to the research objectives and hypotheses will conclude the chapter.

What is a Concussion?

History and definition.

There has been a lack of consistency in the MTBI literature regarding the use and definition of key terms (Yeates, 2010). Terms such as minor closed-head injury/minor head injury, mild traumatic brain injury, and concussion have been used to describe this class of injury. The use of multiple terms is problematic as they suggest different meanings with respect to mechanism of injury, different degrees of severity, and can imply that a concussion is not a brain injury (McKinlay, Bishop, & McLellan., 2011; Weber & Edwards, 2010). There has likewise been a lack of agreement among clinicians with respect to the best guidelines used for assessment and management of concussions (Bodin, Yeates, & Klamar, 2012). The incongruence among definitions has led to inaccuracies in incidence and prevalence estimates which subsequently have impeded the ability

to compare findings across research studies (McKinlay et al., 2011; Yeates, 2010). The variation in definitions is also confusing for the general public who may develop misconceptions, have difficulty recognizing if their injury is severe enough to warrant medical advice, and develop different expectations of their recovery (DeMatteo et al., 2010; Weber & Edwards, 2010). Traditionally, concussions have been viewed as less serious than MTBI, even by clinicians, and self-reports of the injury vary depending on what terms are used. For example, asking athletes if they have ever suffered a "ding" or had their "bell-rung" results in more reports of injury than if the term concussion is used.

Attempts have been made to clarify the definition of concussion over the years by the American Congress of Rehabilitation Medicine, the Congress of Neurological Surgeons the World Health Organization, the International Classification of Diseases, the Canadian Academy of Sport Medicine, and the Concussion in Sport Group (Bodin et al, 2012; Guskiewicz et al., 2004; Kirkwood, Yeates, & Wilson, 2006) which adds to the confusion. The World Health Organization Collaborating Centre Task Force on MTBI provided this definition: "MTBI is an acute brain injury resulting from mechanical energy to the head from external physical forces." (Carroll et al., 2004, p. 115). Concussions are considered to be a subset of MTBI and are typically referred to within the context of sports medicine (Cohen et al., 2009). The recognition of the need for a unanimous description of concussion led to the development of a definition through the consensus of international leaders in the field of head trauma. The

following definition was culminated at the 3rd International Conference on concussion in sport, held in Zurich in November, 2008.

> Concussion is defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces. Several common features that incorporate clinical, pathologic and biomechanical injury constructs that may be utilized in defining the nature of a concussive head injury include:
>
> 1. Concussion may be caused either by a direct blow to the head, face or neck or a blow
>
>   elsewhere on the body with an ‘‘impulsive’’ force transmitted to the head.
> 2. Concussion typically results in the rapid onset of short-lived impairment of neurologic function that resolves spontaneously.
> 3. Concussion may result in neuropathological changes but the acute clinical symptoms
>
>   largely reflect a functional disturbance rather than a structural injury.
> 4. Concussion results in a graded set of clinical symptoms that may or may not involve
>
>   loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course. In a small percentage of cases, however, post-concussive symptoms may be prolonged.
> 5. No abnormality on standard structural neuroimaging studies is seen in concussion. (McCrory et al., 2009, p. 756)

For the purposes of this paper, the terms ‘concussion’ and ‘sports-concussion’ will be used interchangeably and will follow the definition laid out by McCrory et al. (2009) as above.

Incidence.

Concussions are one of the most commonly occurring injuries among children and adolescents in leisure and sporting activities, with over 50% of pediatric concussions occurring in sports (Browne & Lam, 2006). Concussions occur more frequently in contact sports with the highest prevalence in sports such as ice hockey, football, rugby, and fighting sports (McKinlay et al., 2008). Ice hockey players are highly susceptible due to high speeds, the contact between players, pucks, sticks, and hard surfaces, body checking, illegal on-ice behaviour, and the aggressive contact during fights (Echlin, 2010; Williamson & Goodman, 2006). Ice hockey is a sport played by numerous males and females of all ages at various skill levels throughout North America, Europe, and countries of the former Soviet Union (Smith et al., 2011). A recent surveillance study from 2001 to 2005 of Emergency Department (ED) visits by children aged 8 – 13 years old with concussions in the US found that the rates of concussion were highest for football and ice hockey players when the number of participants enrolled in these sports were taken in to account (Bakhos, Lockhart, Myers & Linakis**,** 2010).

A literature review by Honey (1998) on brain injuries in ice hockey revealed a trend of increasing incidence rates with increased level of play. Furthermore, most concussions in ice hockey occur during games rather than practices. The investigation of female hockey player concussions has been

limited; however, initial studies suggest that females may sustain more concussions, and may be more likely to self-report injury and symptoms (Dick, 2009; Schneider, Emery, Kang, Schneider, & Meeuwisse, 2010). The rates of concussion injury in hockey for those 5 – 17 years of age have been estimated at 2.8 concussions per 1000 player-hours. University and elite amateur athletes experienced higher rates with 4.2 and 6.6 concussions per 1000 player hours, respectively (Honey, 1998). Incidence has been estimated to be as high as 20% of players per team each year (Tator, 2009). With over half a million youth involved in minor hockey in Canada, there is a significant health risk for young athletes in Canada (Coghlin et al., 2009). Furthermore, with the incidence rates of concussion likely being underestimates of actual occurrences due to under-reporting by athletes (Kaut et al., 2003; McCrea et al., 2004; Sye, Sullivan, & McCrory, 2006) concussions can pose a substantive burden on the current health care system.

Symptoms.

There are common signs and symptoms associated with concussions, however they are not exclusively seen in concussed individuals (Carroll et al., 2004) and are mostly not visible, therefore not easily recognized and identified (Echlin, 2010). The onset of symptoms can occur right away or signs of injury can be delayed for days or even weeks (Mooney, Speed, & Sheppard, 2005). The recovery of these symptoms can also be variable from several minutes to several days, weeks, months, or even longer (deKruijk et al., 2002). The majority of

individuals with concussion injuries will recover on their own over a 1 – 2 week time period (McCrory et al., 2009).

Given that the brain is responsible for controlling all aspects of our daily functioning, it is not surprising that insult to this important organ can cause disruption in physiological, cognitive, and emotional realms. The most common physical symptoms include headache, dizziness, and fatigue (Cunningham, Brison, & Pickett, 2011). Difficulty with vision, balance problems, nausea, vomiting, ringing in the ears, sensitivity to light and noise, sleep disturbances, and numbness/tingling can also be experienced (Cohen et al., 2009). Loss of consciousness is an important and severe symptom, however it is not a required symptom for a concussion diagnosis and it occurs with far less frequency than is assumed. Cognitive symptoms include confusion, mental fog, difficulty with attention and concentration, decreased speed of mental processing, and memory problem. Emotionally a player might experience irritability, sadness, increased emotionality, and nervousness. Recent evidence from a Canadian study by Cunningham et al. (2011) suggests that the physical symptoms tend to subside sooner, whereas emotional and cognitive symptoms persist. In some patients, cognitive symptoms began to appear over time thus monitoring symptom presentation and changes over time are important.

Although the general trend is that symptoms improve over short periods of time (approximately 7 to 10 days), a small subset of those injured will have a far more complicated outcome (Yeates, 2010). Post-concussion syndrome (PCS) refers to a constellation of somatic, cognitive, emotional, and behavioural

symptoms which persist for a prolonged period. The common PCS symptom complaints are headache, dizziness, fatigue, irritability, and impaired memory and concentration (Cantu, 1996); however, the outcomes and prevalence of PCS in children are less clear (Barlow et al., 2010; Yeates, 2010). Regarding prognosis, the WHO Collaborating Centre Task Force on MTBI has indicated that post-concussive symptoms are usually short-lived in children and "appear to be largely resolved within 2-3 months of the injury" (Carroll et al., 2004, p. 85). Studies have indicated that the outcomes of concussions are dependent on injury characteristics as well as non-injury characteristics, such as history of prior head injury or the family and social environment (Barlow et al., 2010; Yeates, 2010). Validity for PCS in children comes from a recent study of children who presented to an ED where 13.7% of children with MTBI diagnoses continued to have symptoms 3 months after injury, which could not be accounted for by other personal and non-injury factors. Persistent symptoms can lead to negative physical health and psychosocial consequences for children in the long-term. The risk for long-term deficits increases for those who experience multiple concussions and there is evidence that the effects can be cumulative (Guskiewicz et al., 2003). A study by Iverson, Gaetz, Lovell, & Collins (2004) found that high school and college athletes who had a history of three or more concussion performed significantly worse on baseline neuropsychological measures than those with 0 – 2 prior concussions, and they also demonstrated greater declines in their cognitive functioning after injury. Few longer term studies have been

conducted with children and as mentioned the variability in terms and definitions used has made comparisons and clarity on this issue difficult.

Risk for Youth

Children are especially vulnerable to sustaining concussions due to the large number of children who participate in recreational and sporting activities; however, less has been published on concussions in youth below the high school level (Guskiewicz et al., 2004; Kirkwood et al., 2006). Research that is available has demonstrated that concussions and the consequences affect pediatric and adult populations differently. As Kirkwood et al. (2006) have noted it is important to understand and respond to these differences so that proper prevention and management of the injury can occur. It was initially thought that due to plasticity in the immature brain, children would have better recoveries from head trauma than adults; however, in recent years there has been mounting evidence that the developing brain is at greater risk for diffuse injury and that children and adolescents require more time to recover (Grady, 2010). Additionally, children and adolescents seem more susceptible to the life-threatening "second impact syndrome", when a concussed athlete sustains another hit before their first concussion has resolved (Cantu, 1996). Coghlin et al. (2009) have stated that the rising incidence of TBI in hockey is a major concern for youth and exposure to mild head injury may lead to lasting effects that may not surface until the brain completes maturation.

Specific risk factors in minor hockey.

Body-checking can lead to severe bodily and head injuries and is the most common cause of all injuries in ice hockey (Cusimano et al., 2011). There is much debate about this topic and whether body checking should be a part of minor hockey. Some have argued that it is more beneficial for players to be exposed to body checking at lower levels to reduce injuries in the long run as players would learn how to properly give and receive a hit. Several studies have compared across age groups and hockey divisions where body checking is introduced at younger versus older age groups and early exposure to body checking did not decrease the incidence of injuries, but rather increased the risk. A prospective study found that the risk for concussion injuries for Pee Wee level athletes was 3 times greater in a hockey league where body checking was allowed at their level than in a league where body checking was not allowed (Emery et al., 2010). Additionally, a recent study found that rates of injuries to the head and brain especially increased among players after a rule change that lowered the age in which body checking was permitted at the Atom division (Cusimano et al., 2011).

Current recommendations for managing concussions.

The symptoms can be subtle or invisible, therefore, the detection of concussion relies greatly on athlete symptom reporting and upon coaches and parents to notice observable signs of concussion (Kirkwood et al., 2006; Sullivan et al., 2009). Most cases of concussion will not demonstrate findings on CT scans or MRIs as they are due to functional rather than structural injury, however

several tools are available to assist with the evaluation process. Postural stability is commonly assessed as balance can be disrupted within the first 72 hours of injury (McCrory et al., 2009). Brief sideline measures of cognitive disturbances that frequently occur after concussion have been developed to assess the immediate status of players such as the Maddocks questions and the Standardized Assessment of Concussion (SAC). A clinical assessment protocol called the Sport Concussion Assessment Tool (SCAT2) has been developed as a guideline for coaches, trainers, or doctors to comprehensively examine athletes aged 10 years and up in a consistent manner. The SCAT2 includes the above measures in addition to symptom checklist and observations of physical signs, a Glasgow coma scale (GCS), and test of coordination. The SCAT2 can also be given at preseason for a baseline of scores.

Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) is a 20 minute computer-based tool which is used with athletes of all ages to assess the neurocognitive effects of concussions (ImPACT Applications, n.d.). It measures aspects of attention, working memory, reaction time, non-verbal problem solving, as well as response variability. The test can be administered as a baseline measure, to evaluate an individual for a concussion, and to monitor status of recovery to assist with RTP decision making. More comprehensive neuropsychological assessment may be necessary supplement investigative procedures to explore the range of cognitions affected by the injury (McCrory et al., 2009).

The safety guidelines for return to play (RTP), which are designed to optimize good outcomes for players, cannot be enacted without recognition and disclosure of possible injury. Recommendations for safe RTP include accurate and timely detection of a concussion, removal from play, individualized assessment, a monitored step-wise plan for reintroducing physical and cognitive activities, and medical evaluation (McCrory et al., 2009; Smith et al., 2011). Complete symptom resolution and medical clearance is recommended before resuming play (Cantu, 1996).

Knowledge of MTBI/Concussion

Misinformation or having limited understanding about concussion can lead to misidentification of an injury, as well as improper assessment and management. The greatest dangers lie with an athlete continuing to play without knowing they have a head injury or if they have a poor understanding of how to properly manage it, as they can develop more severe or prolonged health consequences and increased risk for reinjury (Cohen et al., 2009). Therefore, it is important to assess the knowledge levels of sports participants (Rosenbaum, 2007). Studies regarding TBI knowledge and misconceptions levels have explored what the general public, health professionals, coaches, as well as some athlete and parent samples understand about the injury. Limited knowledge and endorsement of potentially dangerous misconceptions have been found in the general public (Gouvier, Prestholdt, & Warner, 1988), among athletes (Cusimano, 2009; Kaut et al., 2003; Sye et al., 2006), coaching staff (Cusimano, 2009; Guilmette et al.,2007; Valovich-McLeod, Schwartz, & Bay, 2007), parents

(Sullivan et al., 2009), and health professionals (Davies & McMillan, 2005; Sullivan et al., 2011). Recent research has demonstrated that understanding about concussion is improving, however education is still needed (Ernst et al., 2009).

Some of the most common misconceptions held by the general public have surrounded amnesia, loss of consciousness, and the recovery from concussive events (Gouvier et al., 1988; Willer, Johnson, Rempel, & Linn, 1993). A recent study also highlighted significantly poor knowledge surrounding the necessity for both physical and mental rest after concussion. The researchers administered a survey to physical therapy students to assess their understanding of the concept of rest when recovering from a concussive injury before and after an educational lecture on the current management guidelines and the commonly used Sport Concussion Assessment Tool 2 (SCAT2) protocols (Sullivan et al., 2011). The majority of participants failed to acknowledge the importance of cognitive rest in addition to physical rest when recovering from a concussion and there was shift in understanding after the lecture with the majority recognizing the necessity of a mixed rest approach.

The most recent study regarding knowledge and misconception about sports concussion in the general public was conducted in the United Kingdom (UK) and revealed similar knowledge deficits as in previous studies. Those who self-reported that they have had a prior concussion did not display more accurate knowledge, however were more definite in their responses (i.e. more responses that were ‘true’ or ‘false’ than ‘probably true’ or ‘probably false’) (Weber & Edwards, 2012). The researchers postulated that those who have had a prior

injury may hold a false sense of security, and may have difficulty predicting consequences that differ from their own experience.

Coaches and parents are important components of the "safety net" and represent key figures in identifying concussion injuries and initiating the medical investigation and treatment process (Sullivan et al., 2009). Sullivan et al. (2009) found that parents of high school rugby players in New Zealand demonstrated good basic knowledge of the symptoms and severity of concussion injuries, although only half reported knowledge of the return-to-play guidelines. Valovich-McLeod et al. (2007) found that coaches of young athletes (8-14) were able to identify the most common signs and symptoms of concussion, with better symptom recognition among coaches with prior coaching education. Some misconceptions were noted which signifies the continuing need for more awareness and education. For example, just over a quarter of coaches stated that they would let a symptomatic player return to play. A more recent study by Mrazik, Bawani, & Krol (2011) found that minor hockey coaches were quite knowledgeable about general aspects of concussion, the onset of symptoms, and the requirement for removal from play, but were less familiar with detection of concussion with imaging or the role of genetics.

A recent study from Italy regarding concussion knowledge and sources in rugby players ranging from 13 to 39 years of age revealed that close to 40% of respondents were not well informed about concussion signs, symptoms, and consequences (Boffano et al., 2011). Just under one third of these players reported that they thought it was fine for a concussed player to return to the play

during the same match. In addition, Kaut et al. (2003) explored symptom knowledge in college level athletes playing various sports and found that 56% of the sample was not aware of the possible consequences following a concussion.

Most of the research regarding athlete understanding of sports-concussions has been conducted with adult and high school level populations with very little focus on children and youth. Only one other study could be sourced which explored concussion knowledge of younger athletes. Cusimano et al. (2009) investigated the concussion knowledge of Atom and Bantam minor hockey players from elite (AA) and house league (HL) teams, as well as the knowledge of their parents and the coaching staff who work with them. Most participants could identify the mechanisms responsible for injury, but symptom recollection was substantially weak in the overall sample. Older players and those on who played on the more competitive teams have demonstrated greater knowledge of the signs and symptoms and had a greater knowledge score overall. Close to one half of players identified an incorrect method of concussion treatment, and almost one quarter of all players were not clear on whether a player with a concussion should continue to play. This study demonstrates that there are some significant weaknesses in knowledge among young athletes, which is similar to a 2004 study by McCrea et al. where 36% of high school football players reported that they did not recognize the signs and symptoms of a concussion they had incurred.

Knowledge Sources

Although concussion knowledge has been investigated with various populations and sporting participants, the sources of this knowledge have not been

widely identified. The accuracy and quality of information derived from various sources may be inconsistent, such as from online sources (McKinlay et al., 2011), and this may perpetuate misconceptions. Therefore it is important to examine where athletes are learning about concussion. This information can then help to improve the communication of safety and prevention messages through the most effective means. A recent study by Mrazik et al. (2011) assessed minor hockey coach's knowledge levels and information sources. A counterintuitive finding of this study was that most of the coaches reported that concussion knowledge is important in their role, yet one-third rated their concussion knowledge as limited. Coaches were asked to identify which educational sources had provided them with concussion information and then to rate each source on the degree of helpfulness. Approximately half of coaches identified magazines and newspapers as major sources of information, however most coaches rated them as "not at all" or "mildly" helpful. The Internet was also a frequently identified information source with more variable ratings of helpfulness. Family physicians were a less frequent source of information, however were considered to be the most helpful source.

The sources of information identified by athletes have been variable across studies. A study was conducted with high school rugby players and the most common sources in descending order were teachers/coaches, doctors and sports medics, other players, TV, and the Accident Compensation Corporation/New Zealand Rugby Union (Sye et al., 2006). Similar sources were reported in a recent study of rugby players of a wider age range (Boffano et al., 2011).

Rosenbaum (2007) also surveyed high school student athletes (various sports) and non-athletes, as well as athletic trainers (ATC) and coaches. Athletes received knowledge from parents, friends, physicians, personal concussion/concussion of teammates or opponents, and coaches. For the athletes with an ATC at their school, the trainer was the most commonly reported source followed by personal concussion/concussion of teammates or opponents, parents, physicians, friends, and coaches. The researcher noted that it was surprising to find that coaches had much less influence than expected and that parents and friends were more common knowledge sources. In a later meeting abstract by Rosenbaum & Arnett (2008) the sources did not differentially influence the knowledge and attitudes of high school athletes; however, the most influential sources for high school athletes were medical professionals, parents, and friends.

There is limited knowledge of concussion information sources among non-athletes. Early studies on the misconceptions surrounding brain injury have cited the popular media (Hux, Schram, & Goeken, 2006; Willer et al., 1993) and the Internet (McKinlay et al., 2011) as likely sources of information within the general public.

Attitudes

A problematic and unsafe practice among athletes is the under-reporting of concussion symptoms (McCrea et al., 2004). Although knowledge about injuries is important for their prevention, possessing knowledge has not been consistently shown to influence safer behavioural practices (Morrongiello et al., 2008; Sye et al., 2006). Many inter-related factors influence sports participants' motivation to

comply with safety recommendations. Coaches have identified some barriers to the management of concussion in high school student athletes among which include excessive competitiveness among parents and/or athletes, the view of injuries as a weakness, and the underestimation of the potential risks of concussion (Sarmiento, Mitchko, Klein, & Wong, 2010). Therefore, attitudes and perceptions toward the injury are important to consider in the prevention and management of sports concussions (Morrongiello et al., 2010; Register-Mihalik, 2010).

There is limited research to date regarding the attitudes of athletes with respect to concussion. Rosenbaum (2007) developed a comprehensive survey regarding the knowledge, attitudes, and the reporting of concussion injuries, which he administered with high school students, athletic trainers (ATC) and coaches. The ATCs had the highest knowledge levels followed by the coaches. In comparison, the students had much lower knowledge and there was no significant difference found between athlete and non-athlete students, nor between athletes with access to ATCs at their school and those without. ATCs were found to possess the safest attitudes towards concussion followed by coaches. Students had significantly less safe attitudes, which were similar between athletes and non-athletes. When all participants were taken together, there was a moderate correlation between attitudes and knowledge. Rosenbaum reported that this was a valuable finding as concussion education has the potential to increase the safety of attitudes. The higher degree of unsafe attitudes among the young athletes was thought to be due to less importance given to injuries since youth tend to heal

relatively quickly, and because of the sense of invincibility that is common among adolescents.

This sense of invincibility creates a challenge for injury prevention with this population (Larsman, Eklof, & Torner, 2012). In addition, children have been found to take more risks when they rate the danger level of an activity as low, when they believe they are not personally vulnerable to injury, as well as when they perceive that an injury was due to bad luck (Morrongiello & Rennie, 1998).

Perceiving oneself as vulnerable to become injured has been found to be associated with a decreased risk for injury, whereas perceiving oneself as invulnerable to injury has been related to increased risk for injury occurrences (Morrongiello & Rennie, 1998). Therefore, vulnerability is important to explore in order to reduce the incidence of concussions. Underestimating the seriousness of concussions has been cited as a common reason for not reporting concussion among older athletes (McCrea et al., 2004), thus the degree of perceived severity was considered an important attitude to explore among minor hockey players as well.

Worry influences behaviour in varying degrees and has been found to be related to the perceived probability of injury occurrence and risk taking (Short, Reuter, Brandt, Short, & Kontos, 2004). It can be problematic to have little concern about a threat that is likely to occur as well as being overly concerned about a threat that is unlikely to occur. Worry can have a positive impact, however, on motivating a person to take action to avoid being harmed (Baron, 2000 as cited in Short et al., 2004).

Prior injury experiences can influence attitudes (Morrongiello et al., 2010) as well as the risk for injury and reporting behaviour (Morrongiello et al., 2008; Register-Mihalik, 2010). Register-Mihalik (2010) found that high school athletes with fewer prior concussions tended to have more favorable attitudes toward concussion reporting and may have a greater likelihood of reporting suspected concussions.

Reporting Behaviour

In terms of safety practices, under-reporting concussion injuries and symptoms by athletes is a significant problem and McCrea et al. (2004) published a key study which highlighted this issue. High school football players were surveyed on their reporting behaviours with an objective of informing prevalence rates. The authors found that almost half of those who reported that they had sustained a concussion during the previous season had reported their concussion. The most common reasons for not reporting the injury were thinking their injury was not serious enough to warrant medical attention, not wanting to leave the game, did not know that they had sustained a concussion, and that they did not want to let down their teammates. Concussions were most commonly reported to certified athletic trainers, followed by coaches, parents, and teammates. In Rosenbaum's (2007) study with high school athletes approximately 40% of athletes admitted that they had not reported a concussion in the past. This group also had relatively limited knowledge and held some unsafe attitudes. McCrea et al. (2004) found that once varsity football players were provided with a description of the signs and symptoms of concussion they were more able to

recognize and report injuries over the course of the season. A similar study by Bramley, Patrick, Lehman, & Silvis (2012) with high school soccer players found that athletes who had received previous concussion education were about 30% more likely to indicate that they would always report concussion symptoms to their coach. Thus, it is encouraging that education which aims to increase knowledge and promote safer ways of thinking about concussion injuries may increase the recognition, reporting, and compliance toward return to play guidelines.

Preventative Education

The high prevalence of concussions in youth, the health consequences, and the large direct and indirect costs to society signify that this is a serious public health issue (Wiebe et al., 2011). Some authors have identified a gap in the literature regarding sports-concussion prevention education initiatives as well as the evaluation of current programs for their use and effectiveness (Sawyer et al., 2010). The responsibility for prevention of concussions does not lie solely with athletes as the socio-cultural context undoubtedly has an enormous influence on how athletes think about sports injuries and how they respond to them (Emery, Hagel, & Morrongiello, 2006). Extensive reshaping of the views and behaviours of the general public and of policy makers will take time and will improve with mounting evidence of the direct risk of concussion with physical contact in sports. Education at all levels has been recommended to combat the issue of sports concussion and to reduce the number of concussion injuries in hockey and improve outcomes (Echlin, 2010; Emery et al., 2006). For the purposes of this

study, prevention strategies discussed will focus on athlete adherence to concussion guidelines.

Effective ways of educating young adolescents.

Part of the coaching responsibility involves educating players about risks of injury, thus it is important to "[recognize] athletes as learners" instead of only sports participants (Cassidy, Potrac, & McKenzie, 2006, as cited in Provvidenza & Johnston, 2009, p. 72). It is recommended that efforts to prevent injury occurrences and to encourage proper management of injuries should be more intensive and should begin earlier when working with higher risk population, such as athletes in contact sports (Weissberg, Kumpfer, & Seligman, 2003). Encouraging athletes to adhere to safety guidelines and to engage in less risky behaviour are tremendous challenges with young adolescents due to developmental maturity, and the cognitions, behaviours, and social-emotional tendencies related to their developmental stage (Gerhardstein, 2007). Adolescents may at times demonstrate decision-making and other cognitive skills much like adults, however developmental scientist argue that the needs of this population are different from those of adults and children (Johnson & Jones, 2011). Furthermore, Bennett Murphy et al. (1997) reported that the literature supports that "adolescence is a critical time" to foster adherence to health promoting behaviour as "poor adherence habits tend to persist" (as cited in Larsman et al., 2012, p. 1741).

As mentioned, some of the barriers of engaging adolescents in safety practices reflect their developmental processes. Adolescence is characterized as a

transition period where youth experience growing autonomy in their decision making, increased risk-taking and novelty-seeking, a strong need for social acceptance and affiliation, and development of their identity (Johnson & Jones, 2011). Cognitively, adolescents tend to have less ability to anticipate future consequences, may think they are more invulnerable to harm, make judgments about risk based on their past experiences, demonstrate impaired decision-making when in high-pressure situations, and are more likely to base decisions on short-term benefits than long-term consequences (Larsman et al., 2012). Chen (2000) has found that the strong influence of social approval can lead adolescents to prioritize acting in an unsafe manner even when they know and understand the risks (as cited in Johnson & Jones, 2011).

Interventions with young adolescents must consider the most effective ways to increase knowledge and elicit lasting attitude and behaviour changes. Models of behaviour change such as the Health Beliefs Model can be an effective way to understand behaviour and develop intervention programs. The model proposes that behaviour change occurs when the problem is viewed as serious and likely to occur, that the person has the ability to do something about it, and that the benefits of health promoting behaviour are worth the effort. Concepts such as self-efficacy and "cues to action" (i.e. reminders and promotion of awareness) have been added to the model (Glanz, Marcus Lewis, & Rimer, 1997, as cited in Gerhardstein, 2007). Recently, injury prevention researchers have been emphasizing more encompassing ecological perspectives that take into account the socio-cultural environment, macro-level policies, community characteristics,

peer and family structure and influences, in addition to the individual level behavioural models (Johnson & Jones, 2011).

At the individual level however, effective intervention with athletes should employ persuasive message that combines knowledge with "personalized, thought-provoking messages" (Kirkwood et al., 2006, p. 1363) and the rationale for the individual's engagement in the program from a credible source (Keats, Emery, & Finch, 2012). The presentation of education by health professionals has been effective in injury prevention programs with children and adolescents (Tator, 2009). Physicians should stress to adolescents in particular the rationale behind immediately reporting a concussion and emphasize the benefits of immediate reporting rather than the risks of not-reporting. Programs which focus on knowledge of risks alone have not been shown to be effective in translating into reductions in risky behaviours (Johnson & Jones, 2011). Messages such "It's better to miss one game than the whole season" and "Keeping quiet can keep you out of the game" promoted by the Centres for Disease Control and Prevention (CDC) may appeal more to teens who prioritize their social spheres more than their best personal health interests ("Heads Up", n.d.).

Peer wide education that targets behavioural norms of under-reporting injury, engaging parents in the process of reinforcing safety messages, community level tactics to alter media and professional athlete propagation of unsafe attitudes/behaviours, and policy changes are all essential components of an effective way to tackle this issue with teens (Emery et al., 2006; Sawyer et al., 2010). Dryfoos (1997) recommends that "A set of coordinated, collaborative

strategies and programs" which address protective factors along with the risk factors is essential for prevention of risk behaviours (as cited in Weissberg et al., 2003, p .429). Some of the educational tactics that work best with this age group include: using multiple instructional modalities, experiential activities, presentations from someone who has undergone the experience and is telling their story, less lecturing on what they should not do, and communication of messages and information in age-appropriate language (Provvidenza & Tator, 2006).

Current concussion education programs.

In recent years, educational programs have been developed to try to improve widespread awareness about concussion injuries and how to prevent and manage them. The CDC in the United States has taken action to improve knowledge levels and decrease the common misperceptions about concussion injuries with the development of a public health initiative called "Heads Up". This program targets many audiences with materials in "Tool kits" directed at coaches and trainers, athletes, parents, physicians, and schools. It is promising that there is some positive evidence of the efficacy of this program in improving awareness, as well as in changing attitudes and behaviours of coaches (Sarmiento et al., 2010; Sawyer, et al., 2010). These materials are available online.

Similar attention to the importance of this issue is being paid in Canada. Earlier this year an announcement was made that four organizations in Canada would receive $1.5 million in federal funding for brain injury awareness and prevention in youth team sports ("Concussion Prevention", 2012). The ThinkFirst Foundation of Canada is one of these organizations (non-governmental), which

has already implemented efforts towards this goal with online education courses for parents, teachers, coaches, trainers, and youth athletes to learn more about concussions. The Smart Hockey concussion kit contains similar materials as the Heads Up tool kits, but also includes action plans, a team meeting guide, player and team pledge forms, and personal concussion record forms. A video has also been created to educate and increase awareness about concussion mechanisms, consequences, and prevention of brain and spinal injury and a study was carried out by Cook, Cusimano, Tator, & Chipman (2003) with 11-12 year olds minor hockey players to evaluate its effectiveness. A survey of concussion knowledge was given just before and after the children watched the video, as well as three months later. There were some improvements in knowledge after watching the video that were maintained at the three months, as well as fewer penalties for cross checking and checking from behind were observed in these teams. Since checking from behind is a primary cause of brain and spinal cord injury, the results are encouraging.

"Play It Cool" is another educational program targeted at reducing injuries at the minor hockey level in Canada and was developed with the collaboration of the Canadian Spinal Research Organization in the early 2000s (Montelpare et al., 2012).The comprehensive program encompasses online training curriculum and certification for coaches, an up-to-date interactive website for officials, coaches, parents and for players. The player component is specific for age level and gender and aims to appeal to a young audience by incorporating stories from

professional athletes affected by concussion and taking part in contests and fun interactive activities.

A recent rule change regarding head contact from Hockey Canada, where there is now zero tolerance for hits above shoulder level in minor hockey and female hockey, is evidence that macro-level intervention are beginning to address the limits of relying on players and coaches to reduce the risk of injury. A website dedicated to this rule change and disseminating knowledge of the revision was created and provides resources for helping leagues, referees, coaches, parents, and players to understand and adjust to the changes (http://www.hockeycanada.ca/HeadContactRule#). Videos which demonstrate behaviour that would qualify as penalties are available on the website along with links to the Smart Hockey video, information handouts, awareness posters, return to play guidelines for coaches, and guides for pre-season meetings. The 2011/2012 season was the first season that the rule has come into effect.

Research Objectives

Given that limited knowledge about concussions and underestimating the severity of the injury are related to under-reporting (McCrea et al., 2004) and that little research has been conducted with athletes below the high school level, exploring what youth know and think about concussions is warranted. Gaining a sense of what the current knowledge levels and attitudes are among young adolescents can help inform the process of knowledge translation by determining which facts and messages need the most dissemination and reinforcement and what the most useful sources for transmitting that information might be. The

current study will add to the current body of literature on sports concussions in youth by exploring the views of children and adolescents. This study is intended to provide an initial overview of the understanding of concussions by competitive youth athletes and the extent to which they endorse risky attitudes (e.g. denying the severity of the injury) and behaviours (e.g. not reporting a suspected concussion).

The study employs a cross-sectional design with a unique survey based on similar studies. Youth knowledge levels, sources of information, attitudes toward concussion, and symptom reporting practices will be described. Minor hockey players from Sherwood Park, Alberta and area as well as similarly aged non-hockey playing youth from schools in the area will be recruited for participation. Both female and male hockey playing teams will be approached at the Peewee (11-12), Bantam (13-14), and Midget levels (15-16). Two main objectives guide the development of research questions for the proposed study. The following hypotheses were derived from review of current literature and conceptual knowledge. Some areas that have not been explored to date in the literature are framed as non-directional hypotheses (Creswell, 2009).

Objective 1: Knowledge, attitudes, and behaviours.

The first objective is to examine minor hockey players' general knowledge, attitudes, and concussion symptom reporting behaviour.

Hypothesis 1. *a) The knowledge level of hockey players will be significantly higher than that of non-hockey players.* Trends reveal that coaches, parents, and players demonstrate greater general knowledge compared to the lay

population (Mulhern & McMillan, 2006). Rosenbaum (2007) found that high school athletes and non-athletes did not differ significantly on measures of concussion knowledge, however this trend may not be applicable to younger athletes, as recent study of minor hockey players revealed differences between elite and house league players (Cusimano et al., 2009). If there were disparities between knowledge levels of players at different competitive levels of players, it is plausible that differences would exist between elite players and those who are further removed from the hockey playing environment.

b) The knowledge level of hockey players will be significantly higher at the higher age levels of hockey players. Cusimano et al. (2009) have recently found that older minor hockey players have demonstrated higher knowledge levels than younger players, thus a similar trend is expected in the current sample.

Hypothesis 2. *The ratings of a) severity, b) vulnerability, and c) worry about concussion will significantly differ between participants who have had a concussion in the past and those who have not.* Short et al., (2004) have found higher scores on a measure of perceived risk among athletes who had been previously injured compared to those who had not been injured, which was a finding in other studies as well (Kontos et al., 2000). The authors also found a higher level of worry among those with prior injuries. Ratings of how serious the injury is can vary depending on how serious their prior injury was (Short et al., 2004).

Hypothesis 3. *The ratings of the seriousness of concussions will be significantly associated with the intention to report an injury in the future.* The

link between risky attitudes and behaviours with respect to concussion symptom reporting has been evidenced through the clinical observations of athletes admitting that they did not report because their injury was not that severe (McCrea et al., 2004; Rosenbaum, 2007). The degree to which this association is present in a young adolescent competitive athlete population will be explored.

Objective 2: Sources of knowledge.

The second objective is to explore where the youth are acquiring information about concussion and how helpful they have found these sources.

Hypothesis 4. *The sources of concussion information will significantly differ between hockey players and non-hockey players.* It is expected that players will have obtained more information from coaches, doctors, parents, and the experience of someone with concussion as they would have likely witnessed more concussive injuries due to the high risk in their sport. Non-players may cite more broad sources of information such as television, the internet (McKinlay et al., 2011), or perhaps school.

The following chapter will provide a description of the methods including participant characteristics, instrumentation, and data collection. Chapter 4 will then provide the results of this investigation. The results will be discussed in further detail in Chapter 5 within the context of the reviewed literature and clinical applications.

Chapter Three - Methods

Minor hockey player knowledge and views about sports concussions were explored with a cross-sectional survey research design. Little is known about the knowledge levels and perspectives of this population, therefore this study intends to provide an exploration and description of knowledge trends and views of minor hockey players. Knowledge, sources of knowledge, attitudes, and reporting behaviour were compared across age level (Pee Wee, Bantam, and Midget) and gender, and to a control sample of non-hockey players. This chapter overviews the research methods used in the study including the participants, instrumentation, sampling and data collection procedures, and ethical considerations. Data was analyzed mainly using descriptive statistics.

Participants

Convenience sampling was used to recruit minor hockey players and non-hockey players between the ages of 11 and 17 years to participate in this study. Specifically, athletes who were already participating in current research programs through the University of Alberta were approached to determine interest in participating in this project. Subjects within this age range were all playing minor hockey in leagues where body checking is legal (beginning at the Pee Wee level in Alberta). As noted in chapter 2, body checking has been associated with an increase in concussion injuries (Emery et al., 2010). The data for this study was obtained from both male and female minor hockey players at the Pee Wee (11-12 years), Bantam (13-14 years), and Midget (15-17 years) competitive levels in Edmonton, Alberta and area during the 2011-2012 season. Similarly aged non-

hockey players were recruited to form a comparison sample, which was also a convenience sample. Convenience sampling was chosen for efficiency of survey administration. The disadvantage of using convenience samples is the limited generalizability of the samples to the broader population.

A total of 236 hockey players were recruited for this study; 207 from the Sherwood Park Kings Athletic Club (SPKAC) and 29 from the St. Matthews Hockey and Sports Club (SMHSC) (see Table 1). A total of 183 players participated in the study for a response rate of 77.54%. Only one athlete with parental consent declined participation. The non-hockey players were recruited from grades 6 to 11 at St. Theresa Catholic School and Archbishop Jordan Catholic High School in Sherwood Park, Alberta. These schools were selected since they were from the same geographic location as the hockey players. Recruitment letters were sent home to 182 students from these schools. Fifty three parental consent forms were returned from St. Theresa and none were returned from the high school. Two of the parents declined participation, three students were absent on the day the survey was administered, and 11 were currently playing hockey or had played within the past year and were therefore excluded. Therefore, only 37 students met the criteria for a non-player participant for a response rate of 20.33%.

In total there were 166 male and 54 female participants. The participants ranged in age from 10 to 17 years (mean = 13.6). The low response rate was therefore primarily due to difficulty obtaining parental consent, which was particularly challenging at the high school level. The physical education

instructor that assisted with dissemination of the consent forms at the high school later noted that compliance among their students to bring home and return signed parent permission forms was exceedingly poor. He felt this explained the low response from high school subjects. The completion rates of the survey itself were high, with only one player and two parents who declined participation.

Hockey players.

The minor hockey players were recruited from male and female teams within the St. SMHSC and the SPKAC. In order to maximize the representativeness of the sample there were no exclusion criteria for minor hockey players within the specified hockey clubs and age groups. Of the 183 hockey players who took part in the study, 29 (15.8%) played with the SMHSC and 154 (84.2%) played with the SPKAC. One-hundred and fifty-six (85.2%) hockey players were male, while 27 (14.8%) were female. It is important to note that the numbers are much lower for females as only two of the 13 teams from the clubs mentioned above were female teams. The hockey players ranged in age from 10 to 17 years (mean = 13.7). Players reported that they had played hockey with a team from a range of 1 to 14 years (mean = 8.6). Fifty-five players (30.4%) reported that they have experienced a concussion in the past. Forty-eight (70.6%) of those players reported that they had visited a physician.

Non-hockey players.

Non-hockey players were defined as students who have not played on a recreational or elite hockey team within the last year. Majority of the sample were female, which is a reverse trend from the hockey player sample (10 male and

27 female). This trend occurred because there were 9 males excluded and only 2 females excluded who were currently playing hockey or had played within the past year. The non-hockey players were recruited from grades 6 to grade 9 and ranged in age from 11 to15 years (mean = 13.1). Four participants reported a history of concussion and 2 had visited a physician.

Table 1

Participant Demographic Variables by Participant Group

	Demographic Variables						
Participant group	*N*	Male, *n*	Female, *n*	Age, Mean	Years playing	Concussion history, *n*	Physician seen, *n*
Hockey players	183	156	27	13.7	8.6	55	48
Peewee	58	58	0	11.5	6.9	11	8
Bantam	58	41	17	13.6	8.5	22	21
Midget	67	57	10	15.6	10.2	22	19
Non-hockey players	37	10	27	13.1		4	2
Total	220	166	54	13.6	8.6	59	50

Ethical considerations

The current study was approved by the University of Alberta's Research Ethics Office in October, 2011. Before data collection began consent was also granted from the executive committees from SMHSC and the SPKAC, as well as the office of the superintendent of the Elk Island Catholic School Board. All of the participants were children under the age of 18; therefore parental consent was required prior to their participation in the study. An information sheet describing the purpose and details of the study and two parental consent forms were distributed to parents by the supervising neuropsychologist during a pre-season meeting, coaches or managers of teams, or school personnel. Parents were

instructed to have their child bring a signed consent form to the research session or to a designated person prior to the session (i.e. coach or teacher) if they wished for their child to participate. See Appendix A for the parent information letter and consent form. Only those players with a signed parental consent form at the research session were provided an assent form in exchange (see Appendix B). The researcher explained in person to participants that the surveys would be anonymous and confidential, that their participation was voluntary, that they could ask questions at any time, and the benefits and risks associated were outlined. Only those players who provided an assent form indicating that they agreed to participate were given a questionnaire in exchange.

Instrumentation

Concussion questionnaire.

A unique questionnaire was developed to answer the research questions. Two versions of the survey were created; one for the athlete sample (see Appendix C) and one for the comparison sample (see Appendix D). The two questionnaires asked the same questions except for minor wording changes on the non-hockey player version (e.g. "adult" instead of "coach"; and "sport" or "physical activity" instead of "hockey when asking about behaviour). Permission was granted to use similar questions and formats as the Coaches Concussion Quiz developed for Mrazik et al.'s (2011) study. Several other concussion questionnaires were utilized as resources when formulating the questions such as the Soccer Concussion Quiz (http://www.soccerheadinjuries.org), Heads Up Concussion in Youth Sports: Quiz for Coaches, Athletes, and Parents

(http://www.cdc.gov/concussion/pdf/quiz_Eng.pdf), and the Rosenbaum Concussion Knowledge and Attitudes Survey (RoCKAS) (Rosenbaum, 2007). Specifically, questions about knowledge and RTP were directly formulated from these sources.

Paper-and-pencil administration was chosen over electronic format to allow participants to ask for clarification or assistance, and to ensure that the participant themselves were the ones completing the form without external influence. The concepts and questions covered in the questionnaire were written at a grade 5-6 level so that they could be understood by youth 11 years of age and older. There were 14 questions on the survey, which measured particular aspects of knowledge, the sources of the acquired knowledge, key attitudes or viewpoints, and symptom reporting behaviour practices. Each of these sections is described below.

Knowledge. Four multiple choice and one checklist question made up the knowledge portion of the survey. Consistent with the content from other questionnaires reviewed for this project, the current questionnaire kept to commonly asked knowledge questions. The first knowledge item assessed whether participants know what a concussion is (i.e. "type of injury"). Secondly, participants were asked about their knowledge of what constitutes a concussion, which will be referred to as the "cause" of injury. Knowledge about guidelines on "safe RTP" and the participant's general knowledge of the "prevalence" of sports concussions occur at their age level were also posed. Participants were then asked to identify the most common symptoms of concussion from a provided checklist.

Sources. The participants were asked if they had acquired their concussion knowledge from a series of sources and to identify how helpful the sources have been for increasing their knowledge. A series of sources were provided in a closed question format (yes or no) with one partial open question where they could specify "other" sources not listed. The sources listed were those deemed to be the most appropriate for sporting participants of this age range and were also drawn from examples in prior research (Boffano et al., 2011; Mrazik et al., 2011; Rosenbaum & Arnett, 2010;). If participants indicated that they had received information from a listed source then they were asked to rate the degree of helpfulness of that source out of 1 (*not helpful*), 2 (*moderately helpful*), and 3 (*very helpful*). An open ended question then asked participants to indicate which source has been the most helpful for increasing their concussion knowledge.

Attitudes. Unsafe attitudes about concussion have been reported in the sports medicine literature (McCrea et al., 2007; Rosenbaum, 2007; Sye et al., 2006) and unsafe attitudes are related to unsafe practices in children (Morrongiello et al., 2008) and adolescents (Register-Mihalik, 2010). Several attitudes are implicated in the management of concussion in youth. Three questions were developed to assess the participants' views regarding sports concussions. Underestimating the severity of concussions has been cited as a common reason for not reporting concussion among older athletes (McCrea et al., 2004), thus the degree of perceived seriousness was considered an important attitude to explore among minor hockey players. Perceived seriousness was assessed by having participants rate the severity of concussion compared to that of

other sports injuries. Response options were ranked from "more serious" to "less serious", or participants could answer "I don't know".

Participants were asked about the likelihood that they would become concussed during the current season. This question sought to explore the level of vulnerability that participants may feel toward the injury as perceived invulnerability to injury in youth and among athletes has been related to increased risk taking (Morrongiello & Rennie, 1998). Participants selected from three ranked responses from "likely" to "unlikely", or "I am skilled so it probably wouldn't happen to me". In addition, the degree of worry that participants had about becoming concussed in the current year was an area of interest as a degree of worry can have a positive influence on safety practices (Baron, 2000, as cited in Short et al., 2004). Participants selected responses from "not at all" to "very worried".

Behaviours. The under-reporting of concussions is a serious problem among athletes (McCrea et al., 2004; Williamson & Goodman, 2006). The participants were therefore asked what they "would do" and what they have been told they "should do" if they were to become concussed during a hockey game. In a contingency question, participants who indicated that they have had a sports concussion in the past were asked what they "did" at the time of injury. These three questions were provided in multiple-choice format with similar responses. Another question about symptom reporting was designed to explore the main reasons that athletes fail to report concussions. Participants could choose more

than one listed option and a partial open question which allowed for the inclusion of "other" reasons.

Pilot testing and validity.

Pilot testing of the survey was conducted with a small group of 4 male youths known to the researcher. Two of the youths were hockey players ages 10 and 13 and two played other sports (soccer and lacrosse) and were 11 and 13 years of age. Feedback was obtained from these participants regarding the understandability and wording of questions, the length of questionnaire, and whether any feelings of discomfort or distressed arose during completion. Minor revisions were made to the wording and format of some of the questions to make the questionnaire as easy to read and understand as possible. It was also decided that players under the Pee Wee level would have difficulty reading and understanding the questions. Finally, the questionnaire was reviewed by several experts in the field of head trauma (a neuropsychologist and two sports medicine physicians) and was deemed to have appropriate content validity.

Sampling and Data Collection Procedures

Hockey players.

Recruitment from SMHSC. Participants from the SMHSC were recruited from Pee Wee level teams that were participating in another concussion research project at the University of Alberta by a neuropsychologist specializing in concussion injuries. The purpose of the study was introduced to the coaches and parents by the neuropsychologist during a pre-season meeting for Pee Wee level teams. An information letter outlining the purpose of the study and consent forms

were provided to parents. Parents had the opportunity to ask questions and to provide consent for their child to participate in the study at that time. One player declined to participate in the study, therefore a total of 29 minor hockey players were surveyed that same day at the University of Alberta in two adjacent computer labs. Survey administration procedures are described below.

Recruitment from SPKAC. A concussion seminar for coaches working with the SPKAC was held by the same neuropsychologist mentioned previously where the study was introduced and coaches could sign up on a contact sheet if they were interested in participating. The vice president of the league consulted with executive members of the SPKAC and approval was then provided for all of the teams in the club to be approached for participation in the study. Managers of each hockey team were contacted by phone and subsequently emailed the parent information letter and consent forms, which they then distributed to players via email or in person. Coaches and managers collected the completed consent forms from the players on their respective team. Arrangements were then made to meet with each team prior to a convenient practice to administer the surveys.

Most of the teams were surveyed at hockey rinks in a dressing room and one team was surveyed in a school classroom where a dry land practice session was being held. Participants with consent were identified from the team by roll call from the forms signed by parents. Only those players with parent consent were in the testing room with the researcher. The survey administration was then carried out as described below.

Non-hockey players.

A comparison convenience sample of non-hockey players was recruited through St. Theresa Catholic School and Archbishop Jordan Catholic High School in Sherwood Park, AB. Sherwood Park was chosen because the majority of the hockey player participants were from this urban area adjacent to Edmonton, thus would have similar socio-demographic statuses. The principals granted access to their students and a primary contact from each school assisted with recruitment of students via the disbursement of parent information and consent forms.

Parent consent forms were dropped off for the school personnel. At St. Theresa Catholic School participants were recruited from one grade 6, 7, and 8 class and two grade 9 classes. At Archbishop Jordan High School two grade 10 classes and one grade 11 class were approached for recruitment. Both school contacts reported difficulty collecting completed parent consent forms from students. The physical education instructor from the high school reported that none of the students returned consent forms; therefore data was not collected at that school.

The school psychologist at St. Theresa School arranged for all of the participants to complete the survey on the same day at the school. Two groups of approximately 20 -25 students were brought to a large resource room containing tables and chairs. Students who have played hockey in the last year were identified by roll call from the parent consent forms or if parents had not identified this on the consent form then students were asked directly. These

students were given an Athlete Concussion Questionnaire; however, this data was not intended to be used in the study and was excluded.

Survey administration.

Participants were given a brief and simple introduction to the study. Assent forms were then distributed and the parameters of confidentiality, anonymity, voluntary participation, and the risks and benefits of participation in the study were discussed. Instructions on how to complete the assent form were given and participants were asked whether they had any questions. Those who agreed to participate were then given a self-administered paper-and-pencil questionnaire in the group settings. Participants were asked not to share answers and to try to be as honest as possible. They were encouraged to ask for clarification or assistance on any of the questions and the researcher observed for signs of confusion or difficulty with reading and assisted as needed. Completed assent forms and questionnaires were kept separately to protect anonymity. The data collection process generally took between 15 and 20 minutes.

Overview of Analysis

The data was entered into a spreadsheet and analysed using Statistical Package for the Social Sciences (SPSS) version 20.0. Data was grouped by hockey player and non-hockey player, by gender (for the Bantam and Midget age levels only), and by hockey player age level (males only). The results were reported in terms of the frequency of participants who responded to particular survey items, the percentages, and as bar graphs. The variables of interest in this study were all categorical in nature; therefore comparisons were made between

one survey item and one group variable or between 2 survey items at a time. Cross-tabulations were utilized and when there were a sufficient number of cases per cell a Pearson chi-square statistic was reported. When there was insufficient variability column proportions were compared with a *z*-test for significance at the $p < .05$ level.

The following chapter will present the descriptive data from the survey for players and non-players and comparisons will be made to test the hypotheses. The final chapter will discuss the results within the broader context of the sporting environment and the relevant reviewed literature.

Chapter Four - Results

This chapter presents the results of the data analysis. The characteristics of the sample data will be described first followed by findings organized by the study's two main objectives. Under the first objective, findings will be presented for knowledge items, attitudes and behaviours. The second objective describes the sources of knowledge followed by an examination of their perceived helpfulness. In each section, descriptive statistics for the survey items are provided, followed by inferential statistics which address the hypotheses. The chapter concludes with supplementary analyses of survey items concerning concussion signs and symptoms, and reasons for not reporting concussion symptoms.

Sample Characteristics

Participant information was described in chapter 3 and a summary of these statistics can be found in Table 1.

Hockey players. The mean age of hockey players (n = 183) was 13.68 (SD = 1.852) with a range of 7 years. Age was not normally distributed among hockey players according to the Shapiro-Wilk test of normality (W = 0.942, p < .001). The distribution was slightly skewed to the right (0.046) and slightly flat relative to the standard normal distribution (-0.965). This was most likely related to the selection methods of the sample of subjects. There were similar numbers of participants in each hockey age level (Pee Wee, n = 58; Bantam, n = 58; Midget, n = 67). To remove the confound of gender only male players were included when computing age level comparisons. There were 58 male Pee Wee players, 41

male Bantams, and 47 male Midgets. The mean number of years playing organized hockey was 8.63 (SD = 2.62). The range was 13 years. The number of years playing hockey, however, was normally distributed (W = 0.980, p = .01). There was significant positive correlation between the age and the number of years playing (r = 0.52, p < .001) as well as between the age level and the number of years playing (r = 0.53, p < .001). Therefore, only 'age level' was considered in the data analysis.

Non-hockey players. There was a smaller age range (4 years) within the non-hockey player sample as no data could be collected from the high school. The mean age was 13.16 (SD = 1.191). Age was also not distributed normally among the non-player data (W = 0.890, p = .002). Age level comparisons were not made between hockey and non-hockey players due to the age range disparity, the skewed distribution of player ages, and much smaller sample size (n = 37).

Concussion history group comparisons. Concussion history by participant group is reviewed in Table 1. Comparisons by group were made by cross-tabulating the data and performing a chi-square (X^2) statistical calculation. There was a significant relationship between hockey player status and concussion history in that a significantly greater proportion of hockey players than non-hockey players had suffered a concussion in the past during hockey/other sport or physical activity ($X^2(1, N = 192) = 6.48$, p = .042). Data from participants who circled "I don't know" were removed from this analysis.

There was a significant relationship between age level of hockey players and history of concussion in hockey ($X^2(4, N = 154) = 19.63$, p = .001). A

column proportions test revealed that a significantly greater proportion of Bantam players (compared with Pee Wee players) reported that they suffered a concussion in the past while playing hockey (*z*-test, $p < .05$). Additionally, a significantly greater proportion of Pee Wee players (compared with Midget players) reported that they did not suffer a concussion in the past while playing hockey (*z*-test, $p < .05$). Approximately 9% of Pee Wee, 2% of Bantam, and 27% of Midget players circled that they did not know if they had sustained a concussion in the past or not. A significantly greater proportion of Midget players than Bantam and Pee Wee players reported that they were unsure if they had suffered a concussion in the past while playing hockey. A Bonferroni adjustment to the *p*-values was applied to all column proportion comparisons in this study.

Only Bantam and Midget level players are included when players are compared across gender in all of the following analyses as there were no female Pee Wee participants. In terms of gender difference in concussion history, a greater proportion of female hockey players (42.3%) than male players (34%) reported that they have sustained a concussion in the past, although the different was not statistically significant. However, a significantly greater proportion of male than female hockey players reported that they did not know if they had sustained a concussion in the past (16.5% and 0%, respectively; *z*-test, $p < .05$).

Objective 1: Knowledge, Attitudes, and Behaviours

Knowledge.

The data from each knowledge question in binomial format (correct and incorrect) and across the four response options were cross-tabulated with hockey

player versus non-player status and then with player age level. Pearson chi-square statistics were calculated for each comparison when the cell counts were at or above the expected counts, otherwise a z-test comparing column proportions was explored.

Hypothesis 1. *a) The knowledge level of hockey players will be significantly higher than that of non-hockey players.* Knowledge was assessed with four multiple choice items and a symptom checklist question. Data from the symptom checklist is described in the supplementary analyses section at the end of this chapter. Additionally, players' knowledge of RTP guidelines was assessed with a question asking them what they have been told they should do when they are concussed. This data is described in the attitudes and behaviours section below.

Frequencies and percentages are summarized in Table 2 for each multiple choice knowledge survey item for hockey players and non-hockey players. Nearly all of the hockey players (98.4%) and non-hockey players (97.3%) correctly identified concussion as a type of brain injury. Approximately 87% of players and 73% of non-hockey players correctly identified how brain injury occurs in hockey. Approximately 68% of hockey players and a higher (though not statistically significant) proportion of non-hockey players (75.7%) were knowledgeable about safe RTP guidelines than hockey players. The lowest area of knowledge was the prevalence of concussions in hockey with a significantly higher number of hockey players (44%) compared with non hockey (22%) players responding correctly.

Cross-tabulations compared the four areas of knowledge across hockey players and non-hockey players. There was little variability in the responses for injury type; therefore, a X^2 could not be calculated. Two knowledge areas revealed significant relationships with hockey player status. For instance, a significantly greater number of hockey players than non-hockey players demonstrated accurate knowledge about the cause (X^2 (1, N = 219) = 4.49, p = .034) and prevalence of concussions (X^2 (1, N = 217) = 5.74, p = .017). In addition, a significantly greater proportion of non-players than players think that a player must have a "direct blow to the head", and a significantly greater portion of players responded correctly (z-test, $p < .05$). The hypothesis that knowledge would differ between players and non-players was supported for the areas of cause and prevalence, but not for the identification of the type of injury or RTP guidelines.

b) The knowledge level of hockey players will be significantly higher at the higher age levels of hockey players. The data was cross-tabulated and Pearson chi-square statistics or column proportions z-tests were calculated to examine age level group comparisons (see Table 2). All age groups knew the most about the type of injury with a high degree of accuracy, followed by moderate to high knowledge about the cause, moderate knowledge level of safe RTP, and finally low to moderate knowledge of concussion prevalence. Only one of the knowledge areas measured was significantly associated with age level. Significantly fewer Pee Wee hockey players compared with Midget players were able to correctly identify the cause (X^2 (2, n = 155) = 17.39, $p < .001$). The

hypothesis that the knowledge levels would differ by age level was supported for only one of the multiple choice knowledge questions.

Gender. In addition, no significant differences emerged across these knowledge areas neither between male and female hockey players (Bantam and Midget levels only), nor between the entire sample of males and females.

Table 2

Frequency and Percentage of Knowledge by Player Status and Age Level

		Player status			Player Age Level			
Knowledge question		Player	Non-player	X^2	*Pee Wee*	*Bantam*	*Midget*	X^2
Injury type	*n*	180	36		55	41	57	
	(%)	(98.4)	(97.3)		(94.8)	(100.0)	(100.0)	
Cause	*n*	158	27	4.49*	41_a	$36_{a,b}$	55_b	17.39***
	(%)	(86.8)	(73.0)		(70.7)	(87.8)	(98.2)	
Safe RTP	*n*	124	28	0.90	35	30	39	1.90
	(%)	(67.8)	(75.7)		(60.3)	(73.2)	68.4)	
Prevalence	*n*	79	8	5.74*	21	18	24	0.46
	(%)	(43.6)	(22.2)		(37.5)	(43.9)	(42.1)	

Note: Blank cells indicate that a chi-square could not be calculated due to fewer than the expected cell counts in the cross-tabulation table. Frequencies within rows with differing subscripts indicate a significant difference at least at the $p < .05$ level, using a z-test comparing column proportions.
*= $p < .05$, *** = $p < .001$

League. Although it was not a main question in the study an interesting set of results came from the comparison of Pee Wee players from the two different hockey associations (SMHSC and from the SPKAC). The responses did not differ for type of injury or for prevalence, however a significantly greater proportion of players from the SPKAC correctly identified the cause (X^2 (1, n = 58) = 6.74, p = .009). Specifically, significantly more Pee Wee players from SMHSC than SPKAC circled the incorrect response "has to lose consciousness (get knocked out)" to have a concussion. A significantly greater proportion of SPKAC players also correctly identified the safe RTP guidelines (X^2 (1, N = 58) =

5.84, $p = .016$). Specifically, significantly more Pee Wee players from the SMHSC incorrectly circled that it is it safe to RTP "for the next game, as long as it is at least 2 days later".

Attitudes and symptom reporting behaviours.

Descriptive statistics for attitude and behaviour questions are provided first, followed by the hypotheses for these variables.

Attitudes. Table 3 summarizes the data for the three attitudes that were measured by hockey player versus non-player status, and by player age level. The three attitudes explored include perceptions of the severity of concussions, vulnerability, and degree of concern about getting a concussion. There were lower than expected cell counts in the cross-tabulation analyses for the majority of attitude item comparisons, therefore column proportions *z*-tests were calculated.

Severity. The majority of players ($n = 99$, 55%) perceive concussions to be "more serious" than other sports injures, which was a significantly greater proportion (*z*-test, $p < .05$) than non-players ($n = 8$, 21.6%). Nearly 40% of players ($n = 70$) perceive concussions to be "as serious" as other injuries, while a slightly larger percentage of non-players perceive concussions to be "as serious" ($n = 17$, 45.9%). Approximately 2-3% of both hockey players and non-players stated that they perceived concussions to be "less serious". Four percent of players ($n = 7$) did not know how severe concussions were compared to other injuries, which was significantly fewer than the non- player group where 30% ($n = 11$) were unsure of the severity (*z*-test, $p < .05$).

Among the different hockey age levels, a greater proportion of Midget players than the younger age levels indicated that they perceive concussions to be "more serious" than other injuries. This difference was only significant between Midget and Bantam players (*z*-test, $p < .05$). A greater proportion of Bantam than Pee Wee or Midget players indicated that they perceived concussions to be "as serious" as other injuries. Again, the difference was only significant between Bantam and Midget players (*z*-test, $p < .05$).

Vulnerability. Non-players were given the same attitude questions as players, however for the vulnerability item they were posed a hypothetical question (i.e. "If you were to play hockey, how likely is it that you could get a concussion during a hockey game this year"). In terms of the perceived vulnerability of concussions, 46% ($n = 83$) of hockey players and half of non-hockey players ($n = 19$, 51.4%) reported that they felt that it was "somewhat likely" that they would become concussed in the upcoming year. Eighteen percent of players ($n = 32$) and a higher percentage of non-hockey players ($n = 10$, 27%) felt that it was "likely", although the difference was not statistically significant. Twenty-eight percent of players felt that it was "unlikely" they would sustain a concussion, while a slightly smaller percentage of non-players chose this option ($n = 8$, 21.6%). An additional 9% ($n = 17$) of players chose the response option "I am skilled, so it probably wouldn't happen to me".

A significant relationship between age level and perceptions of vulnerability was not found ($X^2(6, N = 155) = 9.85$, $p = .131$). Approximately half of Midget and Bantam players reported that they were "somewhat likely" to

become concussed, whereas about 30% of Pee Wee players selected this option. In a reverse trend, over 40% of Pee Wee players and approximately 20% of Bantam and Midget players reported that becoming concussed was "unlikely" in the upcoming year. This difference was significant between Pee Wee and Midget players (*z*-test, $p < .05$). The proportions were more similar across the three age levels for the options "likely" and "I am skilled, so it probably wouldn't happen to me".

Worry. Half of hockey players ($n = 92$) and 70% of non-players (n = 26) reported that they were "not at all" concerned about becoming concussed in the upcoming year. This difference was statistically significant (*z*-test, $p < .05$). A large portion of players ($n = 71$, 39%) were "a little bit" concerned about becoming concussed, whereas only 16% ($n = 6$) of non-players chose this option. This was also a statistically significant difference (*z*-test, $p < .05$). A higher portion of Bantam and Midget players reported that they were "not at all" worried when compared to Pee Wee players; however, this was not a significant difference.

There were fewer than the expected cell counts of the cross-tabulation table for gender differences of hockey players in severity, vulnerability, or worry, therefore an accurate X^2 could not be calculated. Column proportions *z*-tests were not significant for any of the attitude items at the $p < .05$ level.

Table 3

Frequency and Percentage of Attitude by Participant Group

	Participant group									
					Hockey player age level					
	Non-player		Player		Pee Wee		Bantam		Midget	
Attitude	*n (%)*		*n (%)*		*n (%)*		*n (%)*		*n (%)*	
Severity										
Less	1	(2.7)	4	(2.2)	4	(7.0)	0	(0.0)	0	(0.0)
As	17	(45.9)	70	(38.9)	$21_{c, d}$	(36.8)	23_{d}	(56.1)	15_{c}	(27.3)
More	8_{a}	(21.6)	99_{b}	(55.0)	$28_{c, d}$	(49.1)	17_{d}	(41.5)	38_{c}	(69.1)
Don't know	11_{a}	(29.7)	7_{b}	(3.9)	4	(7.0)	1	(2.4)	2	(3.6)
Vulnerability									*X^2 value*	= 9.85
Likely	10	(27.0)	32	(17.6)	9	(15.8)	6	(14.6)	12	(21.1)
Somewhat	19	(51.4)	83	(45.6)	18	(31.6)	21	(51.2)	29	(50.9)
Unlikely	8	(21.6)	50	(27.5)	24_{c}	(42.1)	$9_{c, d}$	(22.0)	12_{d}	(21.1)
I am skilled wouldn't happen			17	(9.3)	6	(10.5)	5	(12.2)	4	(7.0)
Worried										
Not at all	26_{a}	(70.3)	92_{b}	(50.8)	23	(41.1)	24	(58.5)	31	(54.4)
A little bit	6_{a}	(16.2)	71_{b}	(39.2)	25	(44.6)	16	(39.0)	19	(33.3)
Quite a bit	4	(10.8)	8	(4.4)	3	(5.4)	0	(0.0)	4	(7.0)
Very worried	1	(2.7)	10	(5.5)	5	(8.9)	1	(2.4)	3	(5.3)

Note. Frequencies within rows with differing subscripts indicate a significant difference at least at the $p < .05$ level, using a column proportions z-test. Subscripts a and b are used for comparisons between hockey player and non-hockey player in each row, whereas subscripts c and d are used for age level comparison

Symptom reporting behaviours.

The frequency data for symptom reporting behaviours of hockey players by gender and age level, as well as the data from non-players are summarized in terms of frequencies and percentages in Table 4. There were lower than expected cell counts in the cross-tabulation analyses for behaviour items, therefore column proportions *z*-tests were calculated.

What have participants been told they should do if they suffered a concussion? Majority of hockey players (95%) and all of the non-players reported that they have been told that they should "stop playing and tell a coach/trainer/adult" if they were to become concussed. Approximately 2% of

players indicated that they would tell the coach/parent after the game. These players were all male; one was a Pee Wee player and two were Midget players. No significant differences were found between hockey players and non-players, or by gender. A greater proportion of Pee Wee players compared to Bantam players reported that they should "keep playing the game and wait to see how they feel", however this difference was not significant.

What would participants do if they suffered a concussion? The majority of hockey players (78.6%) and non-players (89.2%) indicated that they would stop playing and report their injury if they became concussed during a game. This was not a statistically significant difference. Likewise, there were no statistically significant differences by age level. A greater proportion of Bantam players (87.8%) than Pee Wee (75.9%) or Midget players (78.6%), however, reported they would stop and tell. Pee Wee players were more likely to report that they would "keep playing no matter what" and to "tell the coach after the game" than Bantam or Midget players, but results did not reach statistical significance.

The following qualitative descriptions of the different behavioural options are provided for interest's sake, as under-reporting concussion symptoms are a tremendous area of concern. Note that the data described is for all players, therefore age levels include both male and female players. Seven players (approximately 4%) stated that they would not tell anyone and keep playing no matter what. Three respondents each from the Pee Wee and Midget levels chose this response as well as one Bantam player. Eighteen players (9.9%) indicated that they would keep playing and wait to see how they felt. Of these, Midget

players (15.2%) encompassed a slightly greater proportion than Pee Wee (8.6%) or Bantam (5.2%) players. Nine players (4.9%) told their coach/parent after the game and all were male players across the three age levels. Five players (2.7%) responded that they would not tell anyone unless their symptoms got really bad. Even though four of these respondents were male the proportion was actually higher for female players, which is likely due to the much smaller sample of female players. Similar proportions were from the Pee Wee and Midget divisions. The differences between all the proportions across hockey players and non-hockey players, as well as by genders were not significant for intended reporting behaviour.

What did participants who suffered a concussion do? Participants who reported that they had sustained a concussion in the past were asked about what they did at the time of injury. Forty-nine players and three non-players with prior concussions responded to this question. Twenty-one players (42.9%) reported that they stopped playing and told their coach/trainer, with equal proportions across male and female players. Three players (6.1%) told the coach/parent after the game (two were male and one was a female). Nine players reported that they kept playing the game and waited to see how they felt (equal proportions between male and female players). Four players (8.2%) did not tell anyone until their symptoms got so bad that they couldn't play. Even though an equal numbers of male and female players selected this option, the proportion was three times greater for females, which may be due to the unequal sample sizes. Somebody else noticed the concussion or symptoms in 12 of the players (24.5%) and pulled

them out of the game. There was a three-fold greater proportion of male than female players who chose this option. The differences between all the proportions across hockey players and non-players, as well as by age level (males) and gender were not significant.

Table 4

Frequency and Percentage of Symptom Reporting Behaviour by Participant Group

	Participant group				
			Hockey players		
Reporting behaviour items	Non-player *n (%)*	Player *n (%)*	Pee Wee *n (%)*	Bantam *n (%)*	Midget *n (%)*
What should you do?					
Stop and tell	37 (100)	170 (95.)	51 (89.5)	39 (97.5)	53 (96.4)
Tell after the game		3 (1.7)	1 (1.8)		2 (3.6)
Keep playing to see how feel		6 (3.4)	5 (8.8)	1 (2.5)	
Tell a friend nobody else					
Not tell unless so bad					
What would you do?					
Stop and tell	33 (89.2)	143 (78.6)	44 (75.9)	36 (87.8)	44 (78.6)
Keep playing no matter what	1 (2.7)	7 (3.8)	3 (5.2)	1 (2.4)	1 (1.8)
Keep playing to see how feel	2 (5.4)	18 (9.9)	5 (8.6)	2 (4.9)	6 (10.7)
Tell after the game		9 (4.9)	4 (6.9)	2 (4.9)	3 (5.4)
Not tell unless really bad	1 (2.7)	5 (2.7)	2 (3.4)		2 (3.6)
Tell a friend nobody else					
What did you do?					
Stopped and told	2 (66.7)	21 (42.9)	2 (22.2)	8 (57.1)	7 (33.3)
Told after game		3 (6.1)	1 (11.1)		1 (4.8)
Kept playing to see how I felt		9 (18.4)	4 (44.4)	2 (14.3)	5 (23.8)
Told a friend nobody else					
Not tell unless so bad	1 (33.3)	4 (8.2)			2 (9.5)
Somebody else stopped me		12 (24.5)	2 (22.2)	4 (28.6)	6 (28.6)

Note: Chi-square statistics could not be calculated due to fewer than the expected cell counts in the cross-tabulation table. Comparisons were made using column proportions *z*-tests. Frequencies within rows with differing subscripts indicate a significant difference at least at the $p < .05$ level.

Hypothesis 2. *The ratings of a) severity, b) vulnerability to, and c) worry about concussions will differ between participants who have had a concussion in the past and those who have not.* The option "I don't know" under the survey question about concussion history was excluded from the following analyses (statistics regarding the frequency of this response option can be found under the heading Sample Characteristics above).

a) Severity. The option "I don't know" was removed from the list of options for the survey item regarding severity of sports concussions so that only the three levels of severity were explored ("more serious", "as serious", and "less serious"). In order to calculate a chi-square statistic, the data regarding severity was regrouped into two categories (instead of three) to yield the minimum expected count per cell of the cross-tabulation table. One category encompassed the ratings "more serious", and the other encompassed both "as serious" and "less serious". Concussion history and perceived severity and were compared using a two-by-two cross- tabulation. Approximately 61% (n = 35) of participants with a concussion history rated concussions to be "more serious" than other injuries, whereas about 48% (n = 58) of those without a history of concussion rated concussions to be "more serious". Although a greater proportion of those who rated concussions to be "more serious" had a prior concussion, the difference was not significant. Overall, the Pearson chi-square statistic did not reveal a significant relationship between severity and concussion history (X^2 (1, N = 177) = 2.65, p = .104). The hypothesis that those with a concussion history would rate

concussion severity differently than those without a concussion history was not supported.

b) Vulnerability. In order to calculate a chi-square statistic, the data regarding vulnerability to concussions was regrouped into three categories (instead of four) to yield the minimum expected count per cell of the cross-tabulation table. The two options "unlikely" and "I am skilled at hockey, so it probably wouldn't happen to me" were combined and compared with "somewhat likely" and "likely". A Pearson chi- square statistic revealed a significant relationship between vulnerability and concussion history (X^2 (2, N = 191) = 14.13, p < .001). Specifically, participants with a concussion history (n = 35, 59.3%) were significantly more likely than those without a concussion history (n = 54, 40.9%) to report that they are "somewhat likely" to sustain a concussion in the upcoming year. Those who have not suffered a concussion in the past (n = 57, 43.2%) were significantly more likely than those who have had a prior concussion (n = 9, 15.3%) to report that it is "unlikely/wouldn't happen to me". A greater proportion of participants with a concussion history (n = 15, 25.4%) reported that they were "likely" to obtain a concussion in the upcoming year than those without a concussion history (n = 21, 15.9%), although this difference was not statistically significant.

c) Worry. In order to calculate a chi-square statistic, the data regarding the degree of worry about sustaining a concussion was regrouped into three categories (instead of four) to yield the minimum expected count per cell of the cross-tabulation table. The two options "quite a bit" and "very worried" were combined

and compared with the options “a little bit” and “not at all”. A Pearson chi-square statistic revealed a significant relationship between degree of worry and concussion history (X^2 (2, n = 190) = 6.98, p = .031). Participants with a concussion history (n = 29, 49.2%) were significantly more likely than those without a history of concussion (n = 39, 29.8%) to report that they are “a little bit” worried. Those who have not had a concussion in the past (n = 78, 59.5%) were significantly more likely than those who have been concussed in the past (n = 24, 40.7%) to report that they were “not at all” worried. The options “quite a bit/very worried” were reported in equal proportions across the groups at approximately 10% of respondents (prior concussion, n = 6; no prior concussion, n = 14).

Hypothesis 3. *The ratings of the seriousness of concussions will be significantly associated with the intention to report an injury in the future.* As above, the option “I don’t know” among the severity response options was removed. In order to calculate a chi-square statistic, the data regarding severity was regrouped into two categories (instead of three) to yield the minimum expected count per cell of the cross-tabulation table. One category encompassed the rating “more serious”, and the other encompassed both “as serious” and “less severe”. The future intention to report concussions was explored with the survey item that asked athletes what they would do if they sustained a concussion. The six behaviour options on this item were regrouped into two categories. The first category encompassed the option “stop playing and tell a coach/adult” and the remaining options were grouped together to represent “under-reporting”

behaviour. Perceived severity and intended behaviour were compared using a two-by-two cross-tabulation. Approximately 82% (n = 61) of hockey players who rated concussion to be "as serious" as other injuries reported that they would stop playing and tell a coach/adult compared to about 76% (n = 74) of those who rated concussions to be "more serious". Overall, the Pearson chi-square statistic was not significant (X^2 (1, n = 172) = 1.197, p = 0.274). The hypothesis that severity would be related to the intention to report a concussion in the future was not supported.

Objective 2: Sources of Knowledge

The second objective is to explore where youth are acquiring information about concussion and how helpful they have found these sources.

Sources of information.

Hypothesis 4. *The sources of concussion information will differ between hockey players and non-hockey players.* Frequencies are described for hockey players prior to the comparison with non-players. The most frequently identified source of concussion information by hockey players was "parents/guardians", which was reported by 147 (81.7%) of players. The next most frequent source was from "someone who has had a concussion" (n = 135, 77.1%), followed by "coaches" (n = 130, 72.6%), "doctors" (n = 123, 68.7%), "school/teachers" (n = 97, 54.2%), "teammates/friends" (n = 88, 49.4%), "TV/movie" (n = 86, 47.8%), and finally the "Internet" (n =71, 39.7%).

A greater proportion of hockey players than non-players reported that "parents/guardians" were a source of concussion information. This difference

was not significant, but the chi-square approached significance (X^2 (1, N = 217) = 3.71, p = .054). More non-players received information from "teammates/friends" than players (64.9% vs. 49.4%), and this difference also approached significance (X^2 (1, N = 216) = 2.92, p = .087). Hockey players were significantly more likely to report that they have learned about concussions from "coaches" (X^2 (1, N = 216) = 8.17, p = .004) and "doctors" (X^2 (1, N = 216) = 22.52, p < .001) than non-players. The hypothesis that the information sources would differ between hockey players and non-players was supported for two out of the eight sources provided (coaches and doctors).

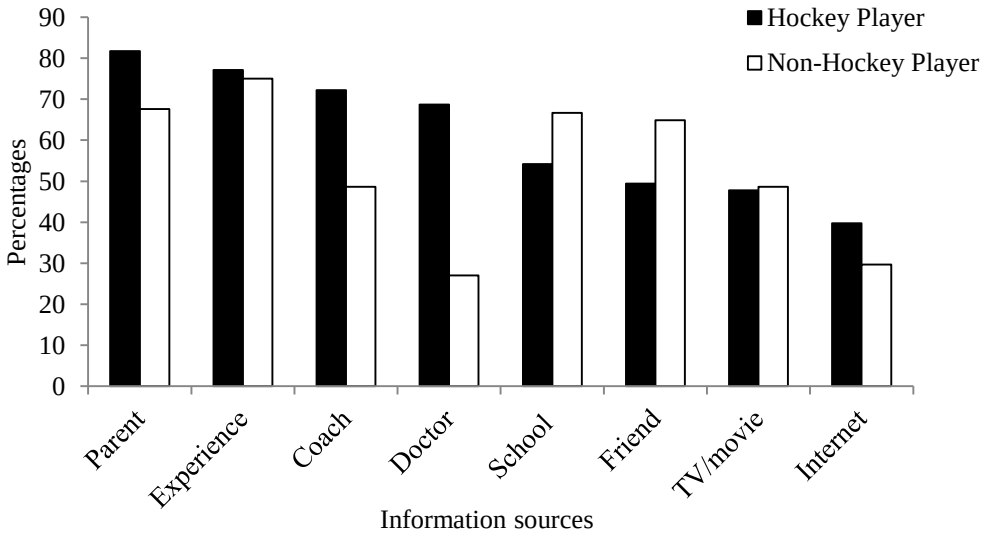

Figure 1. Percentage of Players and Non-Players who have Acquired Information from Various Sources.

Age level. In addition, the three hockey player age levels were compared. Midget players were significantly more likely than Bantam or Pee Wee level players to report that they have learned about concussions from "coaches" (X^2 (1,

$N = 152) = 19.81, p < .001$). Bantam and Midget level players were significantly more likely to report that they have learned about concussions from "doctors" (X^2 $(1, N = 153) = 12.81, p = .002$) than Pee Wee players.

Gender. Male hockey players were significantly more likely to report that they have learned about concussions from "coaches" (X^2 $(1, N = 124) = 12.23, p < .001$) and "Internet" ($X^2$ $(1, N = 124) = 4.81, p = .028$) than female hockey players. A higher proportion of male than female players reported that they have acquired knowledge from "TV/movie". This difference approached significance (X^2 $(1, N = 125) = 3.54, p = .060$).

Other sources. Any other sources of information listed by participants that have helped them to acquire information about concussions are presented in Table 5. Some players provided responses that elaborated upon the sources already provided, therefore are not listed. For example, with respect to TV some participants indicated particular programs such as CBC Hockey Night in Canada, Sports Net, and TSN.

Table 5

Other Sources of Information Listed by Participants

Other sources	*n*	*%*
Personal experience with concussion	5	(2.3)
Other family member	3	(1.4)
Magazine article/books	3	(1.4)
Professional athlete (Sidney Crosby)	3	(1.4)
P.A.R.T.Y program	2	(0.9)
Witnessed a concussion	2	(0.9)
Other (the survey, other sports)	2	(0.9)

Helpfulness of sources.

The most helpful source reported by hockey players was "doctors" with almost 67% rating them as *very helpful*. "Parents/guardians" were the next most helpful, followed by "someone who has had a concussion" and "coaches". The "Internet", "school/teachers", "TV or movie", and "teammates/friends" were the least helpful sources.

When the data regarding the helpfulness of information sources was compared between hockey players and non-players, a significantly greater proportion of hockey players than non-players reported that they have found "school/teachers" as *not helpful* (*z*-test, $p < .05$).

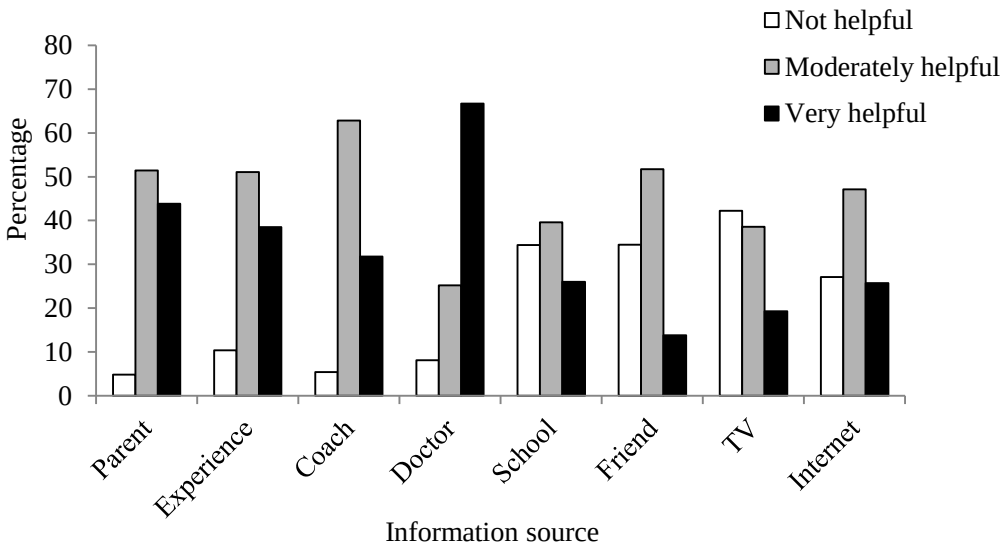

Figure 2. Helpfulness Ratings of Information Sources by Minor Hockey Players

Age level. Age level differences were explored and a significantly greater proportion of Midget than Pee Wee hockey players rated "doctors" as *moderately helpful* (*z*-tests, $p < .05$). A greater proportion of Pee Wee (22%) than Midget

(4%) or Bantam (3%) level players rated "doctors" as *not helpful*, although the difference was not statistically significant. All of the age levels, however, rated "doctors" to be "*very helpful*" in similar proportions.

Gender. A significantly greater proportion of female than male players found that receiving information from "someone who has had a concussion" was *moderately helpful* (*z*-test, $p < .05$), and a significantly greater proportion of male than female players found that receiving information from "someone who has had a concussion" was *not helpful* (*z*-test, $p < .05$).

Participants were given an open ended question which asked them to indicate what the most helpful source has been for increasing their concussion knowledge. See Table 6 for responses given.

Table 6.

Frequency and Percentage of Most Helpful Sources Listed by Participants

Sources	*n*	*%*
Coaches/trainers	39	(17.7)
Parent(s) (3 were also medical professionals)	52	(23.6)
Doctor(s)	56	(25.5)
Teachers/school/school project	12	(5.5)
Other family member	3	(1.4)
Friend(s)/Teammates/other players	7	(3.2)
TV (news, hockey night in Canada, sports centre)	9	(4.1)
Movie/documentary	3	(1.4)
Personal experience with concussion	4	(1.8)
Concussion experience of another person or witnessing a concussion (friend/teammate/other)	18	(8.2)
Magazine article/books	2	(0.9)
Professional athlete (Sidney Crosby/family friend)	2	(0.9)
Other (P.A.R.T.Y program/survey /all of the sources)	3	(1.4)

Supplementary Analysis

Knowledge of signs and symptoms. Participants were given a checklist of concussion signs and symptoms and were asked to select the symptoms that they believed to be the most common after a concussion. Breathing problems and diarrhea were added in as more generalized symptoms to better differentiate participants' knowledge between these unrelated symptoms and the actual symptoms. The majority of participants revealed knowledge of the following common symptoms: headache, dizziness, confusion, memory problems, vision problems, nausea, and fatigue. Loss of consciousness was considered to be one of the most common symptoms by approximately half of all participants. About 13% of participants thought breathing problems were among the most common symptoms and very few (4.2%) thought that diarrhea was common; therefore, it did not appear that participants were responding indiscriminately. When the responses of hockey players were compared to non-players, the symptoms identified were very similar (see Figure 3). Hockey players were significantly more likely than non-players to report that nausea (X^2 (1, N = 217) = 7.44, p = .006) among the most common symptoms. Within the hockey player sample, significantly more female than male players thought that memory difficulties (*z*-test, $p < .05$) were among the most common symptoms.

There were no significant relationships between age level and symptom identification. The general trend was that a greater proportion of older than younger players correctly identified the most common symptoms and younger players were more likely to report uncommon symptoms (see Figure 4). Column

proportions *z*-tests between age level of hockey players revealed that significantly more Pee Wee (n = 7, 12.7%) than Midget (n = 0) players checked off that diarrhea was a common concussion symptom (*z*-test, $p < .05$). The relationship between age level and breathing problems approached significance with younger players endorsing this symptom more frequently than older players (X^2 (1, N = 180) 5.44, p =.063).

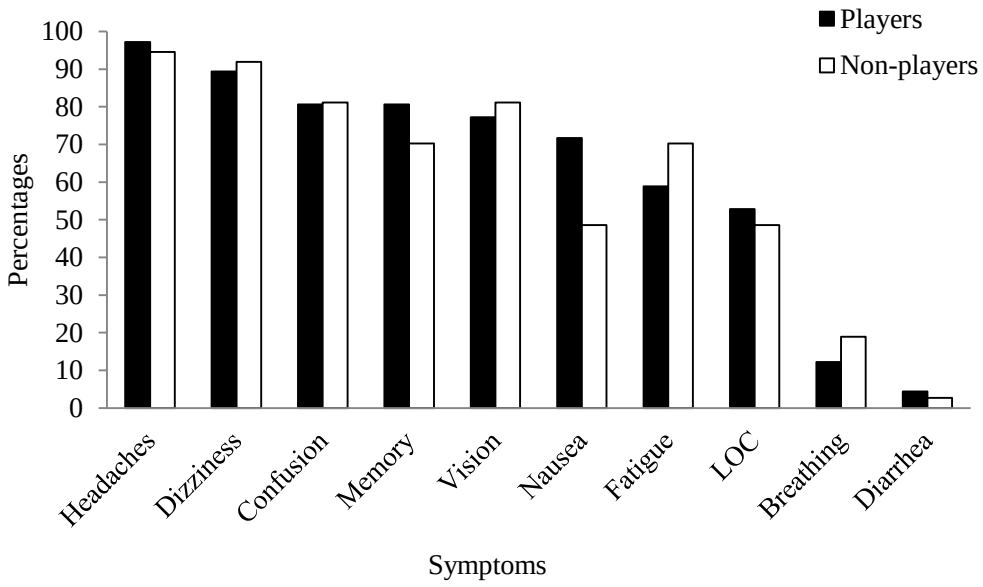

Figure 3. Percentage of Reported Concussion Symptoms by Hockey Players and Non-Players

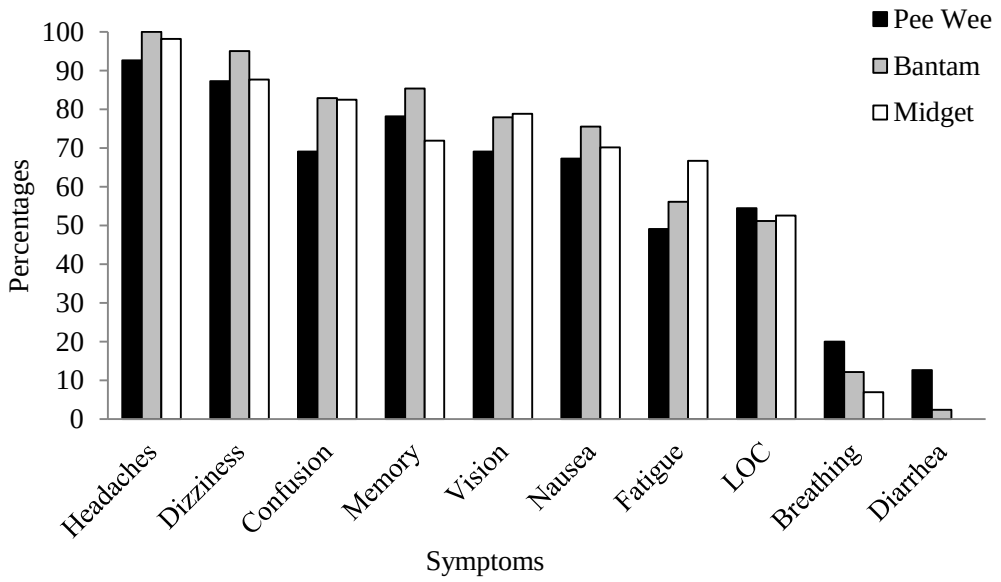

Figure 4. Percentage of Reported Concussion Symptoms by Age Level of Male Hockey Players.

Reasons for under-reporting of concussions. See Table 6 for other frequencies of responses for the survey item asking players why they think a player may not report a concussion. The majority of hockey players (56.8%) and non-hockey players (67.6%) reported that a player would be most reluctant to report their concussion because they want to play. The second most common reason was that the player is not aware that they have a concussion (hockey player = 35%; non-players = 45.9%). The third most common reason was that they would be afraid to let their team down, and this was a significantly more common response among non-hockey players than hockey players (X^2 (1, N = 220) = 4.01, p = .045). The next most common reason was a fear of disappointing their coach. Among the hockey players Midget level players were significantly more likely than Pee Wee players to indicate that a primary reason for a player not reporting a

concussion is because they want to play (X^2 (2, N = 156) = 8.45, p = .015). The frequency of male and female players differed significantly on several of the reasons. A significantly greater proportion of female players than male players to indicated that players would not report their injury because they would not want to disappoint their coach (X^2 (1, N = 125) = 4.85, p = .028) and their parents (*z*-test, $p < .05$)

Participants were asked to write down any other reasons that they felt a player may not want to report their injury. Many of the written responses reflected the idea that the player wants to continue playing and does not want to be taken out of the game. For players who wrote this response f) was entered as a '1' in the spreadsheet if they had not already circled it. The responses included, "the player does not want to feel like a wimp"/ "doesn't want to sounds like a sissy"/"people might think you're soft", "embarrassment", "they are scared the coach will be mad"/ "nervous to tell the coach", other players on the team might think you are faking it, "wants to contribute to the team", "the player is really good", and the player would "have to go to the hospital/doctor".

Table 7

Frequency and Percentage of Reasons for Non-Reporting by Participant Group

Reasons for non-reporting	Participant group									
					Hockey player age level					
	Non-players		Players		Pee Wee		Bantam		Midget	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Disappoint coach	9	(24.3)	40	(21.9)	13	(22.4)	8	(19.5)	9	(15.8)
Disappoint parents	1	(2.7)	21	(11.5)	4	(6.9)	5	(12.2)	5	(8.8)
Not that bad	2	(5.4)	2	(1.1)	1	(1.7)	1	(2.4)	0	(0.0)
Let team down	16	(43.2)	49	(26.8)	19	(32.8)	8	(19.5)	14	(24.6)
Peer influence	3	(8.1)	12	(6.6)	5	(8.6)	2	(4.9)	4	(7.0)
Wants to play	25	(67.6)	104	(56.8)	25_{a}	(43.1)	$19_{a,b}$	(46.3)	39_{b}	(68.4)
Not aware	17	(45.9)	64	(35.0)	24	(41.4)	13	(31.7)	15	(26.3)

Non-hockey players were asked if they were playing any team sports at the time they completed the survey and 73% (*n* = 27) of participants indicated that they were playing one or more team sports with an average of 5.54 years playing with a team and a range of 10 years. Twenty-seven percent (*n* = 10) were not involved in team sports. The most commonly played sports were basketball (*n* = 11, 29.7%), soccer (*n* = 8, 21.6%), and volleyball (*n* = 6, 16.2%). Less commonly played sports were ringette (*n* = 2, 5.4%), futsal (*n* = 2, 5.4%), baseball (*n* = 1, 2.7%), ball hockey (*n* = 1, 2.7%), lacrosse (*n* = 1, 2.7%), and rugby (*n* = 1, 2.7%). All of the non-hockey players with a history of concussion (*n* = 4) were involved with team sports at the time of survey completion with an average of approximately 8.13 years of experience playing with a team.

Given many similarities in the knowledge and behaviour of hockey and non-hockey players, additional analyses were run based on the involvement of non-players in other team sports. Data from three non-hockey players who participated in contact sports were combined with the results of hockey players

and then compared to the remainder of non-hockey players. The results were very similar to the hockey-player versus non-hockey player results presented above. The only additional significant difference that emerged was that a significantly greater proportion of non-players compared to contact players felt that players would not report their concussion out of fear of letting the team down (z-test, $p < .05$), and there was no longer a significant difference in perceived helpfulness of school/teachers for increasing concussion knowledge.

Chapter Five – Discussion

This chapter extends upon the results presented in the preceding chapter. The following discussion provides a summary and interpretation of the research findings, the applied and research implications, limitations of the present study, and recommendations for future directions in this area of research.

Summary and Discussion of Findings: Objective 1

Knowledge.

It was predicted that the knowledge level of hockey players would be significantly higher than that of non-hockey players. This hypothesis was supported on specific questions in which players were significantly more aware of the cause and prevalence of concussions compared to non-players. Of note, even though players were more aware of the prevalence of injuries, there was evidence of deficiencies in knowledge as nearly half of the players think that concussions rarely happen (once per season). Without this knowledge, players may be less likely to suspect a concussion after head contact with a player or hard surface. In contrast, the hypothesis that players would be more knowledgeable about return to play guidelines was not supported. Over 30% of players were not aware that a player must be completely recovered prior to returning to play. In comparison, 25% of non-hockey players were not aware of the correct return to play protocol. Given the similar degree of RTP knowledge between players and non-players, it seems that information about when it is safe to RTP is not reaching players or the message is not being clearly understood by players. The implication of this knowledge deficiency is that a large number of players could resume playing

before their recovery is complete, which places them at a much greater risk for re-injury, worsening of their symptoms, and prolonged recovery (Cohen et al., 2009). It is possible that the non-hockey players sampled were particularly knowledgeable about RTP as 73% reported that they were playing team sports at the time that they completed the survey. The large majority of sports were non-contact in nature and when the data from those who were playing contact sports was combined with that of hockey players, there was still a relatively higher proportion of non-players who knew the correct RTP protocol. The difference, however, was not significant and the relative difference may have been an artifact of small non-hockey player sample size.

The hypothesis that the knowledge level of hockey players would be significantly higher at the higher age levels of hockey was only supported for one knowledge question. This question was regarding the *cause* of concussions, which Midget players were significantly more knowledgeable about than Pee Wee players. However, there were no significant differences between Bantam and Midget players, nor Bantam and Peewee players. The trend of higher knowledge by older players was consistent with other research by Cusimano et al. (2009) where the older players in their sample (Bantam) demonstrated greater overall knowledge scores than the younger players (Atom). The differences in the current study, however, are less pronounced. Older players may know more about the cause and prevalence of concussion because of more prolonged exposure to the injuries and concussions as well as with working closely with knowledgeable personnel (players at the Midget level are more likely to have a certified athletic

trainer working with the team than at young levels).

Signs and symptoms. Players and non-players demonstrated a comparable degree of knowledge of the most common symptoms of concussions. However, a surprising finding was that players did not demonstrate significantly higher knowledge of the signs and symptoms compared to non-hockey players. This may reflect a weakness in current education programs. It may also be unique to the small sample size in this study, something that would need to be explored in a large sample of hockey players. Approximately half of all participants believed loss of consciousness (LOC) to be one of the most common symptoms. While LOC is certainly a sign of concussion, it is not a common occurrence (Collins et al., 2003). Some studies have found only about 8- 9% of college and high school athletes with a concussion had a loss of consciousness (Guskiewicz, Weaver, Padua, & Garrett, 2000; Kaut et al, 2003). Misperceptions regarding LOC have been long held and are a danger in that a player may not think that they have suffered a concussion if they were not "knocked out" and may proceed to keep playing.

Attitudes.

Severity. Most players thought that concussions are *as serious as* or *more serious* than other injuries. This is an encouraging finding, particularly since not viewing concussions as a potentially serious injury is one of the most common reasons for under-reporting among athletes (McCrea et al., 2004). There was far more uncertainty among non-hockey players about the severity of concussions

with 30% choosing the option “I don’t know”, and significantly fewer non-players rated concussions to be *more serious* than other injuries.

Vulnerability. The perceived likelihood of sustaining a concussion did not differ between players and non-players, which is surprising considering that players are at such a high risk. Rosenbaum (2007) also found similar attitudes between high school student athletes and non-athletes. The lack of difference may be due to the common viewpoint of invulnerability among adolescents (Johnson & Jones, 2011; Rosenbaum, 2007). While there are very few studies which have investigated children's perceptions of injury risk in sports, a recent study with junior cricket players has found a decreased perception of the personal likelihood of injury compared to the perception of risk to cricket players in general among youth aged 8 to 16 (White, Finch, Dennis, & Siesmaa, 2011). Therefore, it is also possible that the athletes in the current study have underestimated their risk of injury. The youngest players in the current study were significantly more likely to report that they were *unlikely* to sustain a concussion in the upcoming year. While there have been some inconsistent findings, generally perceptions of risk increase with age among adolescents (Larsman et al., 2012). This difference may be due to increased frontal lobe development in later adolescence which facilitates anticipation of consequences (Johnson & Jones, 2011). With respect to cognitive maturation, a decrease in childhood egocentrism enables youth to take in perspectives other than their own (Newman & Newman, 1997). Older adolescents are able to move beyond concrete thinking and begin to reason with more complex, abstract information

and hypothetical situations when making judgments (Gullota, Adams, & Markstrom, 1999).

Worry. Hockey players were generally not very worried about sustaining a concussion in the upcoming year, with 51% of players reporting that they were *not at all* concerned. They were significantly more likely, however, to express *a little bit* of concern about the injury than non-hockey players, which is in keeping with their heightened risk for getting concussed.

The hypothesis that ratings of the three attitudes would differ based on prior concussion experience was supported for vulnerability and worry, but not for ratings of severity. Previously concussed participants reported slightly greater vulnerability to and concern about sustaining a concussion in the upcoming year than those without an injury history. Those who sustain a concussion are known to be at a greater likelihood of having a subsequent concussion (Buzzini & Guskiewicz, 2006; Guskiewicz et al., 2003), thus the reports of increased vulnerability were congruent with the actual increased risk. This was consistent with a study of collegiate athletes in contact sports that found a positive relationship between prior injury and the perceived probability of becoming injured and worry/concern about injury. As mentioned by Short et al. (2004), this comparison must be made with caution as the current study explored perceptions regarding concussion specifically, rather than to sports injuries in general.

Symptom reporting behaviours.

Most of the players surveyed (95%) knew that they should stop playing and tell their coach if they suspect a concussion, which was consistent with

Cusimano et al.'s (2009) findings. Even though most knew they should stop and tell fewer players said that they actually '*would' stop* (79%), and only 43% of those who had experienced a prior concussion in hockey said that they did stop and tell someone. A quarter of those who were concussed were pulled out of the game by someone else who noticed their injury. In total, approximately 18% of players did not follow safe RTP guidelines (i.e. stop and tell someone). Interestingly, a similar trend was present in the non-player sample where all of the non-players knew that they should stop and tell, fewer (89%) said that they would report, and even fewer (71%) of those who had a concussion said that they did stop and tell. The majority of non-hockey players were involved in team sports, therefore this pattern may reflect adherence to the sports ethic that encourages being tough and playing through pain or injury.

Higher proportions of non-reporting have been identified at the high school and college levels as approximately 30 to 40% of athletes from various sports admitted that they did not tell anyone of their injury (Kaut et al., 2003; Rosenbaum, 2007). Similarly, less than 50% of high school football players reported their injury (McCrea et al., 2004). The smaller proportion of non-reporting at younger levels of play may be due to coaches recognizing player symptoms and removing them from play, a stronger impetus among older players of continuing to play, or a combination of these variables. These findings reflect the common trend of concussion symptom under-reporting by athletes and add to our understanding of this problem by identifying that it is present even at young adolescent levels of play. This underscores the importance of not only education,

but supporting a management system in which athletes, coaches, and parents are given clear direction about steps to take if they suffer a suspected concussion.

All participants were asked why they think a player might not report their injury, and the most frequently chosen option among players was that the player wants to play and is afraid they will be benched if they tell. The second most frequent response was that a player is probably not aware that they have a concussion. Letting the team down and fear of disappointing the coach were the next most frequently cited options. These results are similar to those found among high school football players except the top the reason was that they did not think their injury was that severe (McCrea et al., 2004). Only 1% of minor hockey players in the present study chose a similar option. This may have been due differences in how the question was phrased between the studies (i.e. prospectively vs. retrospectively). Significantly more female than male players noted that the player may be fearful of disappointing coaches and parents. This finding may reflect that males are generally socialized to suppress their fears, distress, and insecurity and are encouraged to demonstrate courage (Newman & Newman, 1997). Therefore, the male participants may have been less likely to select and agree with these options. This expectation would be strongly reinforced in the environment of contact sports that values masculinity, power, and domination (Waldron & Krane, 2005). Female athletes experience more difficulty measuring up to this sport ethic. As a result they may feel a greater need to prove themselves as "real athletes" to their parents and coaches. Increased concern about and attention to interpersonal issues among females may

also heighten this fear. Non-players responses were very similar which indicates that they are aware of or could relate to why a hockey player may not want to report. Among players the fear of disappointing parents, coaches, and the team speak to the strong pressures placed on player to win and "play through pain" in order to gain and maintain social approval.

Overall, it appears that most players possess the knowledge about recommended reporting practices, but a substantial portion is not acting in accordance with that knowledge. Consistent with the current literature other factors are influencing the decision of athletes to not report symptoms or suspicions of a concussion. The present study considered the potential influence of several attitudes and opinions of players. Attitudes were compared to reporting behaviour and the hypothesis that ratings of the seriousness of a concussion would be related to the intention to report a concussion in the future was not supported by this study.

Summary and Discussion of Findings: Objective 2

Sources.

The current survey revealed that the minor hockey players have obtained information about concussions from various sources. The most frequent sources of information were also considered to be the most helpful. The top four sources were parents, coaches, doctors, and someone with a prior concussion experience. It is very positive that hockey parents seem to be talking to their children about concussions and that coaches have taken the time to educate regarding this injury.

It is also of note that those who have been concussed are talking about their experiences, perhaps after being informed about their injury by physicians.

The results are similar to Rosenbaum's (2007) survey of high school athletes where parents, physicians, and personal/other experience with concussion were among the most frequent sources. Friends were listed more frequently, however, and coaches were listed much less frequently than in the current study. Perhaps this indicates that the coaches in the present study take the issue more seriously and are actively educating, or that over time this practice has improved. Similarly, a recent study of rugby players in Italy cited physicians and coaches/trainers among the most frequent sources and TV as an infrequent source. In contrast, rugby players identified school/university as a source far more frequently than the current study, while parents and other players were much less frequently reported sources (Boffano et al., 2011). The large age range of rugby players (13-39 years) may explain some of these differences in sources, as well as sports specific or regional differences in how concussions are conceptualized and managed.

The hypothesis that the sources of concussion information would differ between hockey players and non-hockey players was partially supported. Hockey players were significantly more likely to report that they have learned about concussions from coaches and doctors. This difference makes sense given the degree of contact that hockey players would have with these sources compared to non-players. In a similar vein, older players were generally more likely to report that they have learned about concussions from these sources. In addition, male

players were significantly more likely than female players to report that they have learned about concussions from coaches and the Internet. It is concerning that fewer females reported receiving information from coaches, especially given that females may be more susceptible to incurring concussions and can have a longer course of recovery (Dick, 2009). This difference may be an artifact of a small female sample and would need to be further investigated. It is possible, however, that concussions are talked about more with male players due to the expectation that males play more aggressively and would be expected to incur the injury more frequently. Websites also may be more geared toward a male audience for a similar reason or it is possible that there are differences in information seeking behaviour (i.e. perhaps males are more likely to seek information from the internet).

Helpfulness of sources.

A significantly greater proportion of hockey players than non-players reported that they have found school/teachers as *not helpful*. Concussion information provided in school may be too general to be deemed relevant by players in the sports context. However, when the contact sports participants from the non-player sample were combined with hockey players the difference was no longer significant. A larger sample size for non-players is needed to clarify whether true differences exist. A greater proportion of Pee Wee than Midget or Bantam level hockey players rated doctors as *not helpful* (although not to a statistically significant degree). This finding may indicate that explanations provided by physicians are difficult for the younger players to understand.

Implications for Research and Practice

The results herein can inform the process of knowledge translation, which has been appropriately referred to in the sports context as the transfer of ideas "from lab bench to sports bench" (Provvidenza & Johnston, 2009, p. 68). This study therefore impacts various domains from research to practical applications.

Research implications.

This study supplements the growing body of literature on knowledge of concussions by further clarifying trends and gaps among athletes and extends what is known on this topic by exploring a younger age segment than typically chosen. The research findings highlight that younger age groups should not be overlooked in future research since there were some age level differences even within this study. For example, older players tended to have more accurate knowledge and held slightly safer attitudes (i.e. greater perceived severity of and vulnerability to the injury). The finding that younger athletes are similar to older athletes with respect to under-reporting is an important consideration for epidemiological research as incidence ratings would be underestimates for youth as well.

The results of this study may benefit educational program development, evaluation, and implementation research by identifying the main sources of information for minor hockey players and areas that can be further targeted to increase the athlete exposure to accurate concussion information. The ratings of the degree of helpfulness also suggest where improvements can be made in effectively translating the information to youth.

The findings also suggest that factors such as attitudes and expectations could be influencing reporting behaviour. This implies that considering theories of behaviour change and risk perception in the sports concussion literature could help with our understanding of the complexities behind athlete's reluctance to report concussion symptoms.

Practical applications.

There are many potential applied benefits of the current results for those involved with minor hockey and other youth contact sports. These results have particular relevance and direct applications for the two hockey clubs that participated in this study. Since each of the hockey teams from the SPKAC contributed to the study, the results can meaningfully influence the way that the issue of concussion is conceptualized and how it is managed within the club. A summary report will be prepared for these clubs to disseminate the results, which is hoped to benefit future educational policies and programs.

As Cusimano et al. (2009) suggested, the many reasons that an athlete may not want to report an injury puts "added responsibility upon the coach, trainer, parents and medical staff to recognize the symptoms of concussion, to take appropriate steps of seeking medical attention and to engender a culture of healthy attitudes and behaviours amongst their players" (p. 318). The specific findings and their implications for these stakeholders follows.

Parents, coaches, doctors can benefit from knowing that they are primary sources of information for young athletes about sports concussions. Since parents are the most common source of information, programs to increase their

knowledge would be an essential component for improving awareness among athletes. Sawyer et al. (2010) have stated that one of the largest roles that parents can take is to reinforce safety messages. Coaches are another top source for athlete's information. Hockey leagues and perhaps even government need to take an active role not only to mandate concussion education and to support the development and implementation of such programs, but to also teach coaches the most effective age-appropriate ways to pass this information onto their players. This may be an even more important implication for less competitive leagues without access to athletic trainers or other medical professionals at games.

Parents and coaches would benefit from the knowledge that some athletes may not report injuries out of fear of disappointing them and that this could be particularly relevant for female athletes. This implies that coaches and parents must become more aware of the expectations that they set and the ways in which approval is given to players, directly and indirectly. Parents need to be aware of their own attitudes and behaviours, as well as the importance of striking a balance between supporting their child's health with the child's desires to advance in the sport. Echlin (2010) has pointed out that it can become problematic when parents are overly invested in their child's success as they reinforce the child's fears and results in a decreased priority over their child's health. On the other hand, some athletes may know that their parents will take the issue very seriously and may hide their injury out of fear of no longer being allowed to play.

Physicians were not only one of the most frequent sources of information, but were considered by the minor hockey players to be the most helpful for

increasing their knowledge. This finding provides encouragement that they are effective in their role and that they should keep up with this. Pee Wee players were most likely to consider doctors as *not helpful*, therefore more time and care may be necessary when working with younger players to ensure their understanding. Physicians have the opportunity to directly inform players who have been concussed regarding what a concussion is, how the concussion occurred, what symptoms they might expect, what the recovery process could look like, and provide advice and a plan for returning to activities. Given that the second highest source of information was "someone who has had a concussion" it may be that people who have had concussions become more informed when they seek treatment and then relay that information on to others. The accuracy of this transferred information is unknown, but it is positive that the young players are learning from others. This study supports the recommendation of several researchers that physicians should be the ones to provide education to athletes, whether through programs or through pre-season work with athletes (Boffano et al., 2011; Kirkwood et al., 2006).

Knowing the areas of knowledge deficiency, as well as attitudinal or behavioural trends is also useful information for minor hockey organizations as they are responsible for setting the policies and regulations to protect the safety of players. Knowing which areas that may need greater focus will allow them to put forth their resources in the areas that need it the most. The current study also supports consideration of rule changes and enforcement of those rules by referees in order to protect young players who are dependent on adults for their safety.

Within ice hockey there has been a lot of controversy about whether body checking should be allowed at youth levels considering the tremendous risk. McCrory et al. (2009) suggest that if a "clear-cut mechanism" of head injury exists within a sport that rule changes may be an important consideration for injury risk reduction (p. 440). The incidence of concussion has been shown to increase once body checking is introduced at the Pee Wee level in Alberta, and has not been shown to protect players against future concussions (Cusimano et al., 2011). Young players also seem to lack accurate knowledge of how prevalent concussions are (Emery et al., 2010). In addition, the higher perceptions of invulnerability and decreased ability to anticipate consequence at this age suggest that adults need to step in and take responsibility for reducing their risk of injury. Eliminating body checking at this age level would be one way to accomplish this goal.

The media, sports announcers, and professional players and leagues must also become more aware and responsible for how their messages and actions influence our young players. High profile athletes who have suffered a concussion have garnered public support for the issue of concussion in the past (Delaney, Lacroix, Leclerc, & Johnston, 2000). Sidney Crosby, a role model for many young Canadian hockey players, suffered two concussions within close proximity and was out of play under cautious observations of medical professionals over the course of this research study. Several players listed Crosby as a source of concussion information. The extent to which professional athletes with concussions influenced the knowledge of participants is unknown as the

provided source “someone who had had a concussion” was a broad category which included professional athletes. Cusimano et al. (2009) also point out the influence that professional leagues, players, and the media have on young athletes who emulate the opinions, expectations, and behaviours of professional athletes.

The problem of getting concussion safety messages across to athletes is complex and stages of child development can be overlooked amidst the focus to win and achieve in sports. The field of psychology has much to contribute to this area and managing sports concussions management teams should involve Psychologists as integral members (Kontos, Collins,, & Russo, 2004). Psychologists can play a role in prevention or can be recruited as consultants by sports medicine professionals at the point of injury occurrence. In terms of prevention, there has been very little application of behavioural theories and models to sports injury prevention to date, although there is much merit in doing so to increase the effectiveness of prevention interventions and maintenance of safety behaviours (McGlashan & Finch, 2010). Psychologists with expertise in development and education could contribute by working with parents, coaches, educators, and program developers to foster greater understanding of youth cognitive processes and experiences in competitive sports environments.

Cognitive maturity, for example, greatly impacts how youth learn, assimilate, and apply information and expectations. Psychologist Jean Piaget lends the idea that children move from a stage of concrete to abstract thinking through adolescence where they increasingly gain the ability to formulate hypotheses (Feldman, 2008). The process happens by gradual unfolding through

physical maturation and experience, therefore while adolescents may appear as "little adults" they do not have the cognitive capacity. Another prominent Psychologist, David Elkind, has built upon Piaget's stage model with a focus on adolescence. The idea of adolescent egocentrism is "a state of self-absorption in which the world is viewed from one's own point of view" (Feldman, 2008, p. 100) and limits the ability of adolescents to appreciate and integrate the perspectives of others. Elkind also proposed a type of distorted thinking called personal fables, which are the beliefs by adolescents that what is happening to them is unique and is shared by no one else. These beliefs and cognitive processes can lead to risk-taking and decreased likelihood of taking preventative measures by thinking that they are personally invulnerable to risks (i.e. 'it happens to other people, but won't happen to me') (Feldman, 2008). Over-inflated self-efficacy (Bandura, 1997 as cited in Kontos et al., 2004) and peer influence can also further lead to risky behaviour. Psychologists can therefore work with athletes to help them develop "realistic appraisals of risk" and accurate self-efficacy for under- or overconfident youth (Kontos et al, 2004, p. 203).

Psychologists may also play a role in the aftermath of injury. Sports Psychologists can play an integral role with educating young athletes to help them understand the confusing information about concussions as well as what to expect while recovering, normalize their symptoms and apprehension, and reinforce RTP decisions from medical professionals and help athletes cope. This would be particularly relevant where there are lasting disruptive symptoms that affect educational or social attainment. The emotional impact and sense of loss from

having to withdraw from participation in sports due to multiple concussions or recurring symptoms can be devastating and also may prompt families to seek support from a School Psychologist or private counselling.

Limitations and Considerations for Replication

The present study is limited by the disadvantages of survey research**,** such as the reliance on self-report which can lead to inaccuracies and reporting bias. Another limitation was in the design of the study, which employed convenience samples. This sampling method limits the representativeness that the samples are of the population of elite minor hockey players. As noted in the results, the age of players was not normally distributed which reflects a concern with the representativeness of the sample. A majority of the hockey player participants came from the SPKAC, which may have introduced selection bias. Given that the SPKAC was willing to have all of the teams participate in this study, it is possible that this club takes a more proactive approach the issue of concussions than other clubs and may have more educated staff and participants than the average hockey club. The same issue is apparent with the control sample that was entirely formed of students from one school that may have more or less concussion exposure or hockey knowledge than students from other schools. As noted in our results, the non-player group had a significant number of individuals who were participating in recreation sports and therefore, was likely to have better knowledge of sports injuries like concussions. Using a sample of adolescents who are involved in non-contact sports would make for a better comparison.

Low return rate of parental consent forms turned out to be a great barrier to obtaining adequate sample sizes, although the completion rate was very high. The low response rate was particularly prominent with the non-hockey player sample and presented a substantially greater challenge with older students. Small sample size thus introduces sampling error when making comparisons across groups and limits the generalizability of the results to the larger population. The lack of female Pee Wee team in the convenience sample was also a disadvantage for gender comparisons in particular.

A replication of the study could employ a variety of methods for data collection to enhance the variability within the samples. For example, approaching various hockey clubs in the area and enrolling teams/parents at pre-season meetings, tournaments, or hockey events/camps. Acquiring a larger control sample would be essential to ascertain whether the findings of this study are generalizable. With respect to using a student sample, it may be more advantageous to gather parental consent at the beginning of the year before too many activities begin. Offering a form of incentive for those who participate may also encourage student participation, such as bonus marks for their health or physical education class. Alternatively, the idea of obtaining proper approval to waive the parental consent would make the collection much easier and limit the potential of selection bias. This would be a viable request in this case, as the survey does not ask intrusive questions. In fact, approval was obtained by the office of the superintendent of the Elk Island Catholic School Board to administer without parental consent in this study; however it was very late in the study for

new schools to be approached by the time that the approval was granted. Non-players could be also be accessed through community centres, or through non-sport extracurricular groups/clubs where youth of similar ages and socioeconomic status could be recruited.

Future Directions

Gender differences in concussion incidence, presentation, and recovery between athletes in contact sports is an area that is beginning to receive research attention. The current study was limited in terms of the number of female athletes, however some differences were found in the reasons for reporting, and sources of information. Exploring knowledge and perspectives in greater depth would help to clarify if differential assessment, management, and even education are required for male and female athletes.

Exploring the views of the parents of minor hockey players is an area that also requires increased attention. Given that parents were a major source of concussion information, ascertaining their levels of knowledge as well as their attitudes and opinions would be an important contribution to the literature. Collecting information from parents and their children at the same time would allow for the examination of the transfer of knowledge and attitudes.

Given the finding that school/teachers were not among the most frequent sources for concussion knowledge raises the question about how much attention and instruction are devoted to the topic of concussions and sports concussions throughout a child's development. Beyond the curriculum, the knowledge levels

and views of school personnel are important to investigate since our youth spend much of their time at school.

Conclusions

Overall, players seem to have foundational knowledge that concussions injure the brain and they can identify common signs and symptoms. While they rate the injury as more serious than non-players and report greater concern over the injury, the issues of perceived invulnerability and deficiencies in knowledge about the prevalence and proper management signify that increased efficiency of knowledge translation is needed. The results of the current study support the widespread notion among researchers and the medical community that implementing educational initiatives are imperative for the prevention of sports concussion and reduction of long-term or complicated outcome after a concussion (McCrory et al., 2009). Since players obtain information about concussions from a variety of sources, consistency in the dissemination of information is crucial continuing to reduce misconceptions.

Cultural and societal obstacles towards this goal also became more apparent and cannot be overlooked. The overall desire to play and motivation to stay in the game can be more powerful than doing what a person knows they 'should' do for their safety or what they think they 'would' do. This is a trend that has been commonly observed in higher age level athletes in hockey and other sports, thus we must consider the impact of the cultural and societal expectations and their impact on the perspectives and behaviours of our youngest players.

The safety of players while they develop their skills and strive to advance in placement is therefore a collaborative social responsibility where the least amount of responsibility should be placed on the child (Echlin, 2010; Emery et al., 2006). An environment must be created where athletes are less fearful and reluctant to reporting injuries. Rules and regulations put in place by government, hockey leagues, and executives impact the protocols that coaches and athletic trainers follow. These protocols along with public health standards of practice help raise awareness for parents to make the best decisions for the safety of their children and must be standardized and consistent so that it becomes more socially acceptable for athletes to report suspected injuries. A new law in Philadelphia requires yearly training for coaches and parent signing of an information sheet as well as legal implications for not adhering to RTP guidelines are a large step in the right direction (Boccella, 2012). This is evidence that the issue of sports concussion is being taken more seriously than in the past.

Sports and physical activity can be highly beneficial for the health of youth and prevent future health complications (Emery et al., 2006). In the same token, there are risks involved with sports participation such as injuries that can have a life-long impact on the child and become a barrier to participating in health promoting physical activity if not addressed appropriately. The process of knowledge translation is designed to increase learning and to empower decision making and is seen as essential to improving our health care system (Providdenza & Johnston, 2009). Fortifying an early understanding and appreciation of the severity of concussion injuries will hopefully lead to more informed adult players

with the self-determination to make healthy decisions to maintain their quality of life and ability to play the sports they love.

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Appendix A

PARENT INFORMATION AND CONSENT LETTER

Project Title: Investigating Minor Hockey Players' Knowledge About and Attitudes Toward Concussion

Principle Investigators:
Andrea Perra, Master's student, Department of Educational Psychology, University of Alberta (780) 993-6950, (aperra@ualberta.ca**)**
Dr. Martin Mrazik, Department of Educational Psychology, University of Alberta (780) 492-8052, (mrazik@ualberta.ca**)**

Dear Parent,

My name is Andrea Perra and I am a Master's student in the Faculty of Education at the University of Alberta. I am currently conducting research, which is part of my Master's degree, under the supervision of Dr. Martin Mrazik. I am writing to ask for your consent to have your child participate in my research.

The Purpose of the Present Study

Researchers from the University of Alberta will examine concussion understanding among PeeWee, Bantam, and Midget level athletes as well as non-hockey playing youth. The purpose of the study is to better understand minor hockey players' knowledge, attitudes, and concussion reporting behaviour. The results will help to identify areas where education is needed. Ultimately, our goal is to reduce the number of concussions.

What is a Concussion?

Concussions are brain injuries caused by a blow to the head. This changes the way brain cells function, leading to symptoms that can be physical (headaches, dizziness), cognitive (problems remembering or concentrating), or emotional (feeling depressed). Concussions can have short-term or long-term impact on athletic performance.

Why Study Concussion?

Hockey is one of the most popular sports world-wide. Researchers have suggested that concussions are on the rise among minor hockey players. Recent research estimates that concussions account for about 15% of injuries. Many concussions improve on their own; however, some athletes are at greater risk for complex and long-term problems. Young athletes generally take longer to recover and can experience worse symptoms than adults. These outcomes can affect their ability to play and keep up with school and their social interests. Continuing to play while injured is a major factor that can make the outcome worse. Athletes may continue to play if they are not aware that they are injured, or if they want to hide their symptoms. These are recognized problems among athletes at the high school level and above; however, more research is needed with younger athletes. In addition, little is known about what the general population of youth, who are also impacted by concussions, understand and think about the injury. Therefore, surveying non-hockey players will provide valuable insight and a baseline to compare the athletes to.

What will be involved?

If you agree, your child will take part in a 15 minute session, during which he or she will complete a short (14 item) paper-and-pencil questionnaire. Along with the knowledge, attitude, and behaviour questions, your child will also be asked their age, whether they have played hockey or if they play other sports, number of years playing organized sports, and history of prior concussion.

This session will take during a health or physical education class at your child's school. The researcher will provide your child with a brief overview explaining that they will be asked questions about what they think and know about sports concussion. Your child will be asked if they agree to participate and will be ensured that their responses will be kept confidential and anonymous.

It is highly unlikely that the questions will cause your child discomfort; however, researchers will be available to talk to if your child becomes upset. If your child reports serious health concerns that need medical attention, you will be contacted and given suitable referrals. Also, if there is reason to suspect serious harm to your child, I am obligated to notify the appropriate persons.

Participation in this study is voluntary, and your child is free to withdraw at any time. Incomplete surveys will be destroyed and the data will not be used in the study. Your child's name will not appear on the questionnaire and the identity of participants will not be revealed in any report produced from this study. All information collected will be treated confidentially and will be stored in a secure location in compliance with the University of Alberta Standards for the Protection of Human Research Participants. The information will be destroyed five years after the completion of this project.

The findings from this research are intended to be used in my Master's thesis, as well as in research articles and presentations. Only group results from all participants will be shared and published. A summary of findings will be available to interested parents when the study is complete. Parents can request a copy of this summary by contacting me via email (aperra@ualberta.ca) or phone (780-993-6950).

If you consent to allow your child to participate in this study, please complete and sign the consent form. Please return the completed consent form directly to the teacher or with your child, and keep a copy for yourself. If you have any questions or concerns about the study please contact me or my supervisor, Dr. Martin Mrazik, via email (mrazik@ualberta.ca) or phone (780-492-8052) at your earliest convenience.

If you have any questions or concerns about you or your child's rights as a participant, or how this study is being conducted, you may contact the University of Alberta's Research Ethics Office at 780-492-2615. This office has no affiliation with the study investigators.

I thank you for sharing in the effort to promote well-being and injury prevention among our youth and young athletes.

Andrea Perra
Department of Educational Psychology
University of Alberta
Email: aperra@ualberta.ca
Phone: 780-993-695

Please return this form with your child

PARENTAL CONSENT FORM

Project Title: Investigating Minor Hockey Players' Knowledge About and Attitudes Toward Concussion

Principle Investigators:
Andrea Perra, Master's student, Department of Educational Psychology, University of Alberta (780) 993-6950**, (**aperra@ualberta.ca)
Dr. Martin Mrazik, Department of Educational Psychology, University of Alberta (780) 492-8052, **(**mrazik@ualberta.ca)

Please answer the following questions:

Parent/Guardian's Name: _____

Child's name: _____ Child's age: _____

Has your child played on a hockey team **within the last year** (recreational or elite levels)? Yes No

	Yes	**No**
Do you understand the benefits and risks in taking part in this research study?	___	___
Have you had an opportunity to ask questions and discuss this study?	___	___
Do you understand that you are free to leave the study at any time without having to give a reason?	___	___
Do you understand the issue of confidentiality?	___	___

I agree to have my child take part in this study: Yes ☐ No ☐

_____ _____
Parent or Guardian's Name (Please Print) **Today's date**

_____
Parent or Guardian's Signature

Appendix B

INFORMATION AND ASSENT FORM

Faculty of Education
University of Alberta
Edmonton, AB, T6G 2G5

Researcher Information
My name is Andrea Perra and I am a student at the University of Alberta. I am inviting you to take part in a research project that I am working on with Dr. Martin Mrazik. This project is a part of my Master's of Education program at the University.

Purpose
You are being asked to join in a research study about what youths your age know and think about sports-related concussions.

What will you be asked to do?
If you agree, you will be asked to fill out a questionnaire which will take about 10 minutes.

Please do not write your name on the questionnaire. I will not tell your parents or anyone else what your answers are. Your personal information will not be shared with anyone or written in any reports.

You do not have to be in this study and no one will be upset with you if you decide not to take part. Even if you start, you can stop later if you want. You can ask questions about the study at any time.

This form and the questionnaire will be kept in a safe place for five years after this study is finished. Then they will be destroyed.

Benefits
If you decide to take part in the study, you will be helping to increase what researchers know about sports concussions. We hope that this helps to make sports and other physical activities safer in the future.

Risks
It is not likely that answering the questions will make you feel uncomfortable. If you do feel uncomfortable, you can talk about it with the researchers.

If you have any questions or concerns about this study, please feel free to contact me by email (aperra@ualberta.ca) or phone (780-993-6950) or my supervisor, Dr. Martin Mrazik, by email (mrazik@ualberta.ca) or phone (780-492-8052).

Thank-you very much for your time,

Andrea Perra
Department of Educational Psychology
University of Alberta

INFORMED ASSENT FORM

<u>This assent form will not be accepted without parental/guardian consent.</u>

Please answer the following questions:

	Yes	**No**
Do you understand that the researcher will be gathering information about what youths my age know and think about sports-concussions.	___	___
Do you understand the benefits and risks in taking part in this research study?	___	___
Have you had a chance to ask any questions you have about the study?	___	___
Do you understand that you are free to leave the study at any time without having to give a reason?	___	___
Do you understand that your information and answers will not be shared with anyone?	___	___

I agree to take part in this study: Yes ☐ No ☐

_____ _____

Your Name (Please Print) **Today's date**

_____

Your Signature

Appendix C

Athlete Concussion Questionnaire Date: _____

Information

How old are you? _____ Please circle: Male or Female

What level of hockey are you in this year? _____

How many years have you been playing hockey with a team? _____

Have you ever had a concussion during any activity? (Please circle)

Yes No I don't know

If yes, did you see a doctor?

Yes No I don't remember

Read the questions carefully and circle the best option.

1. A concussion is:
   a) An injury to my brain
   b) An injury to my spinal cord
   c) A cut or bruise on my skin
   d) I don't know

2. To have a concussion a player:
   a) Has to lose consciousness (get knocked out)
   b) Has to get a direct blow to their head
   c) Feels badly after any hit
   d) Has to have symptoms (like headaches, feeling dizzy) after a hit to the head

3. If you hit your head during a game and think you have experienced a concussion, what would you do?
   a) Stop playing and tell the coach or trainer
   b) Not tell anyone and keep playing no matter what
   c) Keep playing the game and see how I feel
   d) Tell the coach/parent after the game
   e) Not tell anyone unless my symptoms get really bad
   f) Tell a friend but nobody else

4. **If you have ever had a concussion before,** please answer this question. What did you do the last time you got a concussion in hockey? (Please be honest. Remember, your answers are confidential.)
   a) Stopped playing and told my coach or trainer
   b) Told the coach/parent after the game
   c) Kept playing the game and waited to see how I felt
   d) Told a friend but nobody else
   e) Did not tell anyone until my symptoms got so bad that I couldn't play
   f) Somebody else noticed my concussion or symptoms and pulled me out of the game

5. From what you have been told, what should a player do if they think they got a concussion?
   a) Stop playing and tell a coach or trainer

b) Tell the coach/parent after the game
c) Keep playing the game and wait to see how they feel
d) Tell a friend but nobody else
e) Not tell anyone unless their symptoms get so bad that they can't play

6. Sometimes a player *does not* want to tell the coach if they think they have a concussion. This is **most likely** because: (You can circle more than one option)

a) The player's coach might become disappointed in him/her
b) The player's parents might become disappointed in him/her
c) Concussions are not that bad of an injury
d) The team is counting on the player to win games
e) Most athletes wouldn't tell the coach, so he/she doesn't want to either
f) The player really wants to play and is afraid he/she might get benched if he/she tells the coach
g) The player does not know for sure that he/she has a concussion
h) Please write any other reasons_____

7. A player can return to play after a concussion:
a) When his/her symptoms are mostly better
b) When he/she feels completely better
c) When his/her symptoms are not worsened by activity
d) For the next game, as long as it's at least 2 days later

8. In your opinion, compared to other sporting injuries, concussions are:
a) Less serious
b) As serious as other injuries
c) More serious
d) I don't know

9. How often do you think players get concussions playing hockey at your level?
a) Often (several times each game)
b) Sometimes (once a game)
c) Rarely (once a season)
d) Never

10. How likely is it **<u>that you</u>** could get a concussion during a hockey game or practice this year?
a) Likely
b) Somewhat likely
c) Unlikely
d) I am skilled at hockey, so it probably wouldn't happen to me

11. How worried are you about getting a concussion this year?
a) Not at all
b) A little bit

c) Quite a bit
d) Very worried

	Not helpful	Moderately helpful	Very Helpful

12. What do you think **most people** would feel like if they got a concussion?

___Loss of consciousness/knocked out
___Headaches
___Confusion
___Diarrhea
___Nausea or throwing up
___Blurred Vision
___Feel tired a lot of the time (fatigue)
___Breathing Problems
___Balance Problems/ dizziness
___Memory Problems

Please check off all the options below that you think are **most common**.

13. This question asks **where** you have learned about concussions. These are called sources. **If you say 'Yes'** to any source of information listed below, then please circle the number that describes **how helpful** you found the information (1, 2, or 3).

Have you learned about concussions from:

		Not helpful	Moderately helpful	Very Helpful
a) Coach(s)?				
Yes No				
If you circled **Yes**, how helpful was the information?	1 2 3			
b) Parents(s)/ Guardian(s)?				
Yes No				
If you circled **Yes**, how helpful was the information?		1	2	3
c) Doctor?				
Yes No				
If you circled **Yes**, how helpful was the information?		1	2	3
d) Teammate(s)/ Friend(s)?				
Yes No				
If you circled **Yes**, how helpful was the information?		1	2	3
e) Internet?				
Yes No				
If you circled **Yes**, how helpful was the information?		1	2	3
f) TV or Movie?				
Yes No				
If you circled **Yes**, how helpful was the information?		1	2	3
g) School/ Teacher?				
Yes No				
If you circled **Yes**, how helpful was the information?		1	2	3

h) Someone who has had a concussion?

(E.g. a teammate, professional athlete, friend, or family)
Yes No
If you circled **Yes**, how helpful was the information? 1 2 3

i) Have you learned about concussions from any other sources that are not listed above?

Please write_____

14. Which source has helped you **the most** to learn about concussions?

_____

Thank-you for your participation!

Appendix D

Concussion Questionnaire Date: _____

Information

How old are you? _____ Please circle: Male or Female

Have you played on a competitive hockey team in the last year? Yes or No

Do you play any other team sports? Yes or No

If **Yes,** Which sports? _____

How many years have you played sports with a team? _____

Have you ever had a concussion during **any** activity? (Please circle)

Yes No I don't know

If yes, did you see a doctor?

Yes No I don't remember

Read the questions carefully and circle the best option.

1. A concussion is:
   a) An injury to my brain
   b) An injury to my spinal cord
   c) A cut or bruise on my skin
   d) I don't know

2. To have a concussion a hockey player:
   a) Has to lose consciousness (get knocked out)
   b) Has to get a direct blow to their head
   c) Feels badly after any hit
   d) Has to have symptoms (like headaches, feeling dizzy) after a hit to the head

3. If you hit your head during a physical activity or sports game and think you have experienced a concussion, what would you do?
   a) Stop playing and tell an adult (like a coach or parent)
   b) Not tell anyone and keep playing no matter what
   c) Keep playing and see how I feel
   d) Tell the coach/parent after I'm finished the activity
   e) Not tell anyone unless my symptoms get really bad
   f) Tell a friend but nobody else

4. **If you have ever had a concussion before,** please answer this question. What did you do the last time you got a concussion during a physical activity? (Please be honest. Remember, your answers are confidential.)
   a) Stopped playing and told an adult (like a coach or parent)
   b) Told an adult /parent after the game
   c) Kept playing and waited to see how I felt
   d) Told a friend but nobody else
   e) Did not tell anyone until my symptoms got so bad that I couldn't play
   f) Somebody else noticed my concussion or symptoms and had me stop what I was doing.

5. From what you have been told, what <u>should</u> a hockey player do if they think they got a concussion?
   a) Stop playing and tell a coach or trainer
   b) Tell the coach/parent after the game
   c) Keep playing the game and wait to see how they feel
   d) Tell a friend but nobody else
   e) Not tell anyone unless their symptoms get so bad that they can't play

6. Sometimes a minor hockey player ***does not*** want to tell the coach if they think they have a concussion.
   This is **most likely** because: (You can circle more than one option)
   a) The player's coach might become disappointed in him/her
   b) The player's parents might become disappointed in him/her
   c) Concussions are not that bad of an injury
   d) The team is counting on the player to win games
   e) Most athletes wouldn't tell the coach, so he/she doesn't want to either
   f) The player really wants to play and is afraid he/she might get benched if he/she tells the coach
   g) The player does not know for sure that he/she has a concussion
   h) Please write any other reasons_____

7. A hockey player can return to play after a concussion:
   a) When his/her symptoms are mostly better
   b) When he/she feels completely better
   c) When his/her symptoms are not worsened by activity
   d) For the next game, as long as it's at least 2 days later

8. In your opinion, compared to other sporting injuries, concussions are:
   a) Less serious
   b) As serious as other injuries
   c) More serious
   d) I don't know

9. How often do you think players get concussions playing hockey at your age level?
   a) Often (several times each game)
   b) Sometimes (once a game)
   c) Rarely (once a season)
   d) Never

10. If you were to play hockey, how likely is it **<u>that you</u>** could get a concussion during a hockey game this year?
    a) Likely
    b) Somewhat likely
    c) Unlikely
    d) I am skilled, so it probably wouldn't happen to me

11. How worried are you about getting a concussion this year?
    a) Not at all
    b) A little bit
    c) Quite a bit
    d) Very worried

12. What do you think **most people** would feel like if they got a concussion? Please check off all the options below that you think are **most common**.

___Loss of consciousness/knocked out	___Blurred Vision
___Headaches	___Feel tired a lot of the time (fatigue)
___Confusion	___Breathing Problems
___Diarrhea	___Balance Problems/ dizziness
___Nausea or throwing up	___Memory Problems

13. This question asks **where** you have learned about concussions. These are called sources. **If you say 'Yes'** to any source of information listed below, then please circle the number that describes **how helpful** you found the information (1, 2, or 3).

Have you learned about concussions from:

	Not helpful	Moderately helpful	Very Helpful
a) An Adult (like a Coach)?			
Yes No			
If you circled **Yes**, how helpful was the information?	1	2	3
b) Parents(s)/ Guardian(s)?			
Yes No			
If you circled **Yes**, how helpful was the information?	1	2	3
c) Doctor?			
Yes No			
If you circled **Yes**, how helpful was the information?	1	2	3
d) Teammate(s)/ Friend(s)?			
Yes No			
If you circled **Yes**, how helpful was the information?	1	2	3
e) Internet?			
Yes No			
If you circled **Yes**, how helpful was the information?	1	2	3
f) TV or Movie?			
Yes No			
If you circled **Yes**, how helpful was the information?	1	2	3
g) School/ Teacher?			
Yes No			
If you circled **Yes**, how helpful was the information?	1	2	3

	Not helpful	Moderately helpful	Very Helpful
h) Someone who has had a concussion? (E.g. a teammate, professional athlete, friend, or family)			
Yes No			
If you circled **Yes**, how helpful was the information?	1	2	3

i) Have you learned about concussions from any other sources that are not listed above?

Please write_____

14. Which source has helped you **the most** to learn about concussions?

_____

Thank-you for your participation!