

Concussions in Ice Hockey

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Abstract

This literature review will summarize, compare, and evaluate the reviewed studies addressing and investigating the relationship between concussion and the sports of hockey. We will accomplish this by identifying prevalence rates, recognizing common mechanisms of causation, describing and discussing prevention and care, and summarizing the results to provide implications for further studies. We conclude by indicating the important mental health issues as well as potentially severe and long-lasting impact concussions can and do have on those that receive them as well as on the friends and families of those who sustain a concussion.

Introduction

We define concussion according to the definition set forth by the 2012 Zurich committee (14). This type of injury has the ability to interfere with the way the brain works by affecting **memory, judgment, reflexes, speech, balance, coordination, and sleep patterns**. Concussions are a potential negative outcome of a strike to the head or other body parts, which may cause significant movement of the brain, also known as jarring. Although this type of traumatic brain injury (TBI) can be very severe, most people who experience a concussion do not fully realize, understand, or report its **short- and long-term effects**.

This literature review will examine the sport of ice hockey as a potential cause of a TBI by summarizing, comparing, and evaluating studies spanning the last decade. We choose the last decade in order to be as up-to-date as possible. Also, there has been much media and scientific interest in the short- and long-term effects of sports concussions on those who experience them, adding to the motivation behind the current article and the methodology we used to pick articles to review. Identification of prevalence rates, recognition of common mechanisms of causation, description and discussion of prevention and care, and summarization of the results will help provide implications for further studies on the potential association between ice hockey play and concussion severity.

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Much recent research attests to the importance of studying the short-term and long-term impacts of ice hockey concussions. According to Toy et al. (19), TBI is a common consequence of ice hockey, and these authors advocate for more studies examining the **pathophysiological link between concussion and possible cognitive decline**. Similarly, Pedersen et al. (16) speculated on the impact early-life ice hockey concussions may have on late-life consequences, including chronic traumatic encephalopathy. Pedersen et al. (16)

also examined the issues related to return-to-play considerations. The return-to-play issue is critical and also was highlighted recently by Kroshus et al. (12), who reported that athletic identity often impacts the underreporting of concussion symptoms in male college ice hockey players.

One factor relevant in the study of ice hockey's impact on concussion rates pertains to the overall goal of preventing injuries from occurring. According to McIntosh and McCrory (15), a wide range of head and neck injury risks is present in sports, including catastrophic injury, memory problems, physical and mental disability, social and emotional problems, as well as rehabilitation and employment issues. A **concussion is an injury associated with various contact sports and is most often identified with the sports of boxing, football, ice hockey, and martial arts**. The various impacts of concussion became a primary issue for discussion among the media, sports sponsors, sports medicine professionals, and, according to Powell (17), athletes during the 1990s. Agel and Harvey (2) note that **ice hockey is a high-speed collision sport with recognized injury potential**. Since concussions are potentially serious injuries that may lead to loss of player time on the ice, the problem of concussions in professional hockey has attracted much recent attention, according to Wennberg (20). Also, Benson et al. (5) observed that **postconcussion headache, low energy or fatigue, amnesia, and abnormal neurological examination results were significant predictors of time loss of play among professional hockey players**.

Since concussions in past decades have been predominantly underreported in sports (20,21), National Hockey League (NHL) prevalence rates have theoretically increased in recent years; however, the abrupt increase and subsequent plateau in concussion rates since 1997 suggest that increased recognition and reporting may be primarily

responsible for the apparent increase in incidence rates. Wennberg (20) also states that reported concussion rates in the NHL in the last 5 years is more than triple that of the previous decade — **potentially due to bigger, faster players, new equipment, and harder boards and glass.** In a later study, Wennberg and Tator (22) analyzed the concussion incidence and time lost from play due to concussions during the past 10 NHL seasons. The results suggested that the **incidence of concussions remains high and the average lost time from play per concussion has increased, reflecting increased injury severity in recent years** or, alternatively, increased adherence to modern management guidelines preventing premature return to play. Similarly, Benson et al. (4) studied incidence rates and found that team physicians reported 559 concussions during regular season games with an estimated incidence rate of **1.8 concussions per 1,000 player-hours.** Wennberg and Tator (21) found incidence rates ranging from a high 1.81 per 1,000 athlete exposures to a low 1.04 athlete exposures, as **forwards experienced a disproportionately high percentage of concussions.** Williamson and Goodman (23) also have found that concussions are considerably underreported by youth hockey players and team personnel. Thus, this practice is not just confined to professional athletes in the NHL.

In research conducted on the mechanisms of causation of concussions in ice hockey, risks of direct contact to the head leading to jarring are predominantly increased with the allowance of body checking. Body checking is a defensive tactic of ice hockey, which allows players to use a shoulder or hip to strike another opponent who has possession of the puck. According to Cusimano et al., (10), body checking is a leading cause of injury among minor league hockey players. Macpherson et al. (13) agree, suggesting that body checking is the predominant mechanism of youth hockey injuries. Body impact or collision also has been identified as a risk factor underlying all sports-related concussions, according to Wennberg (20). More specifically, Agel et al. (1) found that the greatest number of game injuries (approximately 50%) resulted from player contact, whereas practice injuries resulted from either contact with another object (such as the puck) or noncontact (such as the boards, which mark the ice arena boundaries).

With regard to children, Cusimano et al. (10) have examined the age at which body checking is introduced to young athletes and found that the odds of injury increased with decreasing age of exposure to body checking. Emery et al. (11) state that the risk of concussion and all injury was more than **threefold higher among Pee Wee ice hockey players (age, 11–12 years) in a league that allowed body checking than among those in a league that did not.** Like **wise,** Macpherson et al. (12) agreed and found increased injuries attributable to checking where checking was allowed. Due to these findings, policies have been put in place in an effort to reduce children injury rates (18). In 2011, USA Hockey's board of directors passed the Progressive Checking Skill Development Program. The program has been successful and has resulted in a faster, yet safer, game overall. Such policies regarding the age at which hockey players are introduced to body checking require further examination and follow-up (13) but have been shown to be successful.

Several studies also have examined the fundamental differences in rules among male and female ice hockey players. Agel and Harvey (2) reported that body checking is permitted in men's hockey but not allowed at any level for female players — arguing that the injury patterns in collegiate hockey should reflect this fundamental difference in how the game is played. This study in particular found high rates of concussions from player contact. The concussion rate in females was higher than expected but still not as high as that in males. **Player contact was the leading cause of concussions in game situations for 41% of female players and 72% of male players.**

Reduced risk of TBI lies in attention to safety (18). According to McIntosh and McCrory (15), there have been few formal evaluations of injury prevention methods. Approaches that are considered, or have been proven, to be successful in preventing injury include implementation of helmet standards in ice hockey and increased helmet wearing rates, use of full face guards (3), and changes in rules associated with body contact. Although these standards help reduce concussion rates, total prevention has not been achieved. Biasca et al. (6) stated that the numbers of minor traumatic brain injuries and cerebral concussions are increasing and cannot be completely eliminated by any kind of protective equipment. Prevention strategies, such as the introduction of the “no body checking from behind” rules have become effective in decreasing the number of severe spinal injuries (18). Their study (6) also suggests that a new “head checking” rule should reduce minor traumatic brain injuries in the same way in following years. Implementation of the International Sports Injury System also may improve epidemiological analysis of the head, face, and spinal injuries worldwide, thereby providing an internationally compatible system for continuous monitoring of risk factors, protective effects of equipment, effects of changes in rules, and, hopefully, prevention of injuries.

Appropriate recognition of signs and symptoms and proper knowledge about concussions also may help aid in concussion prevention strategies. Coghlin et al. (7) assessed the ability of parents and guardians to recognize concussion symptoms in their 13- to 14-year-old children who played hockey. These authors wanted to assess the ability to recognize different signs and symptoms listed on the Sport Concussion Assessment Tool as well as eight detractors consisting of signs and symptoms not associated with postconcussive syndrome. Results suggested there is a disconnect with regard to key components of recognizing **symptoms of a concussion, and these symptoms include difficulty with sleep, disorientation, and emotional irritability** (5). Mothers displayed a significant ability to better recognize signs and symptoms of concussions when compared with fathers. Cusimano (9) also studied knowledge about concussions by acknowledging that postconcussive symptoms are among the most important features of the diagnosis of concussion in sports — recommending that athletes not return to play while still symptomatic. Other features include “clinical symptoms, physical signs, cognitive impairment, neurobehavioral features, and sleep disturbance,” according to the consensus statement (14).

Lack of knowledge about concussions could therefore be one of the main detriments to concussion prevention in

hockey. Cusimano (9) found that about 25% of adults and about 25%–50% of children could not recall any symptoms or recalled only one symptom of a concussion from memory and from what they know in general. Additionally, a significant number of people had misconceptions about concussion in hockey, which could lead to serious health consequences and creates a need for better preventive and educational strategies. Almost half of the players and a fifth of the adults incorrectly stated that a concussion was treated with medication or physical therapy, while nearly one-quarter of players did not know whether an athlete experiencing symptoms of concussion should continue playing. These are very troubling statistics, further indicating the need for better and more comprehensive concussion education programs for players, coaches, parents, and teachers.

To this end, the ThinkFast Canada Smart Hockey program (8) is an educational injury prevention video that teaches the mechanisms, consequences, and prevention of brain and spinal cord injury caused by ice hockey. Knowledge transfer and behavioral outcomes in 11- to 12-year-old hockey players who viewed the ThinkFast injury prevention video were assessed. The evaluation consisted of testing concussion knowledge before, immediately after, and 3 months after exposure to the video. According to Wennberg and Tator (22), the number of causes and mechanisms of concussion named by players increased from 1.13 to 2.47 and from 0.67 to 1.22, respectively — with a sustainable effect after 3 months. The study showed some improvements in knowledge and behaviors after a single viewing of the ThinkFast video; however, the findings require confirmation with a larger sample to understand the sociobehavioral aspects of sports that determine the effectiveness and acceptance of injury prevention interventions, according to Cook et al. (8).

Care and management of concussions relies primarily on research and recent scientific findings. Powell (17) was one of the first to express the importance of management. Concussion is an injury that results from a wide variety of mechanisms and has numerous signs and symptoms that are common across different types of injury. Management strategies for concussion require a strong body of research from a variety of different disciplines, and it is essential that research efforts focus on both prevention and management and that the clinicians and researchers work closely toward their common goals. Management and identification of the negative consequences of concussion often begins at home with the parent or parents increasingly called upon to be knowledgeable about what a concussion is and what it can do (7). It is likely the case that much underreporting of the negative consequences of concussion is the direct result of concussion knowledge ignorance (23). It is important for sports medicine professionals to continue to stay updated on advances in understanding concussions and how to care individually for each player who sustains a concussion. This can range from being able to identify the minor and major aspects of a concussion (9) as well as what the long-term effects of a concussion can be (16,19). Sports and sports-related concussions are fast becoming a potentially major mental health crisis in this country not only from an emotional point of view but also from a financial point of view with regard to medical care costs, loss of work and

productivity, and the link between early life concussion(s) and potential late-life consequences (16).

Conclusions

Our article has examined recent studies within the past decade regarding ice hockey and concussion as a mechanism to detail the importance of the short-term and long-term effects concussions can have on hockey players. This review covered school-aged children, who are often the most vulnerable, all the way up to college-level players. The insidious nature of the impact concussions have on the human brain accumulates over time and over the number of concussions a player receives during their play, oftentimes resulting in late-life effects consistent with dementia and other brain abnormalities. We also have discussed prevention and care issues, as the numbers of concussions in ice hockey are on the rise and the resulting short- and long-term injuries are gaining national and international attention. This is an important mental health issue given the potentially severe and long-lasting impact concussions can and do have on those that receive them as well as on the friends and families of those who sustain a concussion.

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