



POLICY STATEMENT

Reducing Injury Risk From Body Checking in Boys' Youth Ice Hockey

COUNCIL ON SPORTS MEDICINE AND FITNESS

KEY WORDS

athletic injury, injury prevention, concussion, body checking

ABBREVIATIONS

AAP—American Academy of Pediatrics

AE—athlete-exposure

CHIRPP—Canadian Hospitals Injury Reporting and Prevention Program

CI—confidence interval

IRR—injury rate ratio

OR—odds ratio

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abstract

FREE

Ice hockey is an increasingly popular sport that allows intentional collision in the form of body checking for males but not for females. There is a two- to threefold increased risk of all injury, severe injury, and concussion related to body checking at all levels of boys' youth ice hockey. The American Academy of Pediatrics reinforces the importance of stringent enforcement of rules to protect player safety as well as educational interventions to decrease unsafe tactics. To promote ice hockey as a lifelong recreational pursuit for boys, the American Academy of Pediatrics recommends the expansion of nonchecking programs and the restriction of body checking to elite levels of boys' youth ice hockey, starting no earlier than 15 years of age. *Pediatrics* 2014;133:1151–1157

INTRODUCTION

Ice hockey is a high-speed sport enjoyed by increasing numbers of children and adolescents in an expanding geographic distribution of the United States. It can subsequently become a lifelong recreational activity, enjoyed by many adults well into their senior years. According to USA Hockey (the national governing body for amateur ice hockey in the United States), there were more than 350 000 youth (305 000 boys, 50 000 girls) younger than 19 years participating in hockey programs in 2011–2012, increased from approximately 200 000 in 2000, when the American Academy of Pediatrics (AAP) published “Safety in Youth Ice Hockey: The Effects of Body Checking.”^{1,2} Like football, rugby, and wrestling, boys' ice hockey is categorized as a collision sport in that intentional physical contact may be used as a strategic technique. A body “check” is defined as a defensive player's intentional tactic to separate the puck carrier from the puck—not to injure or intimidate the opposing player—with a distinct and definable moment of impact (“hit”). In contrast, body “contact” is also a defensive tactic in which the athlete's body is used to legally block or impede the progress of the puck carrier, without delivering a hit to separate the carrier from the puck. Unlike other collision sports, hockey is played on a hard surface, contained by unyielding walls (“boards”) and acrylic windows (“glass”). Previous safety interventions focused on protective equipment and enforcement of rules have largely eliminated dental, eye, and facial injuries in youth hockey and greatly decreased cervical spine injuries. However, because of ongoing concerns that a high

number and proportion of boys' ice hockey injuries are attributable to body checking, the AAP has elected to reassess its 2000 recommendation that "body checking should not be allowed in youth hockey for children age 15 years or younger." Because body checking is not allowed at any level of girls' or women's ice hockey, this statement focuses on boys' youth ice hockey.

INJURY EPIDEMIOLOGY

Every year in the United States, an estimated 12 590 players younger than 19 years seek care in the emergency department for ice hockey–related injuries⁵; the yearly estimated incidence of ice hockey–related injuries among 9- to 14-year-olds increased by 163% from 1990 to 2006.⁴ For the years 2008–2012, the total injury rate for boys' high school ice hockey in the United States ranged from 2.03 to 2.56 injuries per 1000 athlete-exposures (AEs, ie, 1 athlete participating in 1 practice or competition), with a game-related injury rate of 4.18 to 6.08 per 1000 AEs, second only to boys' high school football (total injury rate, 3.61–4.02 per 1000 AE; game-related injury rate, 11.28–12.72).^{5–8} For this same time period, the proportion of severe injuries (>21 days' time loss) sustained during competition in boys' ice hockey (6%–17%) was comparable to that in football (6%–12%). A companion AAP

policy statement on tackling in youth football is in development.

Risk of Injury From Body Checking

Youth ice hockey leagues are typically stratified by age (Table 1) and competition level, as determined by talent, which is often associated with increasing training time, volume, and intensity as well as more extensive travel to games and tournaments. Because there have been several rule changes in boys' youth ice hockey over the past decade, the association between body checking and injury has become a focus of rigorous scientific examination (Table 2). Several investigators have examined cross-sectional data from the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) injury surveillance system. A 2006 analysis of data on 4736 hockey injuries from CHIRPP between 1995 and 2002 found that the majority of the injuries in younger divisions (10–13 years of age) occurred in Ontario, where body checking was allowed at those ages, and nearly half of those injuries were related to checking.⁹ Another analysis of CHIRPP data from 1994 through 2004 on 8552 hockey-related injuries (52.2% attributable to body checking), after a rule change in 1998 that lowered the age for body checking (from 12–13 years to 10–11 years of age), showed that the odds of a body-checking-related injury increased twofold in

the newly allowed checking divisions.¹⁰ In contrast, a retrospective analysis of data from 1997 through 2007 found that the number of body-checking-related injuries for which players were treated in 2 Ontario emergency departments did not change significantly after a rule change in 2002 that lowered the age at which body checking was introduced from 12 to 13 years to 9 to 10 years of age.¹¹ Research examining the same 2002 rule change in a data set from Alberta similarly noted no increase in visits to emergency departments for body-checking-related injuries in that province.¹² However, the majority of other cohorts studied have demonstrated increased risk of injury with body checking.

In a 5-year study of youth ice hockey players 4 to 18 years of age, injuries from unintentional collisions were more common than were injuries from intentional contact,¹³ but the injury rates for both intentional and unintentional collisions were over 3 times higher (and the overall risk of injury nearly 4 times higher) in divisions that allowed body checking.¹⁴ A 2006 Canadian study of 986 youth ice hockey players 9 to 16 years of age estimated that 45% of all injuries occurred as a result of body checking.¹⁵ Comparisons within the same youth ice hockey programs have demonstrated that older age groups that allowed body checking sustained 3 to 5 times higher injury rates than the youngest age group, which did not allow checking.¹⁵ A large prospective study comparing 2 cohorts of 11- and 12-year-olds (Pee Wee) in Canadian provinces with (Alberta) and without (Quebec) body checking demonstrated that the rate of injury was more than 3 times higher in Alberta, including severe injury defined as time loss more than 1 week (injury rate ratio [IRR], 3.30; 95% confidence interval

TABLE 1 Current Age Jurisdictions in Youth Ice Hockey in North America^a

| Category | Age (y) on December 31 of the Playing Season | Where Body Checking Is Allowed in 2013–2014 Season |
|----------------------------|--|--|
| Initiation (in Canada) | <7 | Nowhere |
| Mite (US), Novice (Canada) | 7 and 8 | Nowhere |
| Squirt (US), Atom (Canada) | 9 and 10 | Nowhere |
| Pee Wee | 11 and 12 | Nowhere ^{b,c} |
| Bantam | 13 and 14 | US, Canada |
| Midget | 15–17 | US, Canada |

^a Age categories were shifted down by 1 y in Canada in 2002.

^b In the United States, age of legal body checking in games raised from Pee Wee to Bantam starting with 2011–2012 season.

^c In Canada, age of legal body checking in games raised from Pee Wee to Bantam starting with 2013–2014 season.

TABLE 2 Estimated Risk of All Injury and Concussion From Body Checking

| Study | Estimate of Risk of Body Checking (All Injury) | Estimate of Risk of Body Checking (Concussion) |
|-------------------------------|--|--|
| Hagel, 2006 ¹⁷ | Rate ratio 1.9 (CI 1.4–2.4) | Rate ratio 3.4 (CI 1.4–8.4) |
| Emery, 2006 ¹⁵ | Pee Wee, RR 2.97 (CI 1.63–5.8) | Pee Wee RR 3.4 (0.93–18.61) |
| | Bantam RR 3.72 (CI 2.08–7.14) | Bantam RR 4.04 (1.17–21.54) |
| | Midget RR 5.43 (CI 3.14–10.17) | Midget RR 3.41 (1.02–17.87) |
| Macpherson, 2006 ⁹ | OR 1.83 (CI 1.58–2.11) | OR 1.42 (0.98–2.05) |
| Emery, 2010 ¹⁶ | IRR 3.26 (CI 2.31–4.60) | IRR 3.88 (1.91–7.89) |
| Cusimano, 2011 ¹⁰ | OR 2.20 (CI 1.70–2.84) | OR 10.08 (2.35–43.29) |
| Darling, 2011 ¹³ | Rate ratio 3.75 (CI 1.51–9.34) | |

RR, relative risk.

[CI], 1.77–6.17).¹⁶ Two systematic reviews of the literature published in 2009 (20 studies) and 2010 (10 studies) have examined the association between body checking and injury in boys' ice hockey. All but 1 of their included studies demonstrated that body checking increases the risk of all injuries, with the meta-analysis of 5 studies performed by Emery et al reporting a combined IRR of 2.45 (95% CI, 1.7–3.6).^{17,18}

Specific Risk of Concussion

As noted in the 2010 AAP clinical report "Sport-Related Concussion in Children and Adolescents," concussion is an increasingly recognized concern in many youth sports in the United States, including ice hockey.¹⁹ A recent study of high school sports revealed that the concussion rate in boys' ice hockey (5.4 per 10 000 AEs) was second only to football (6.4 per 10 000 AEs); however, concussions accounted for a greater proportion of total injuries in boys' ice hockey (22.2%) than any of the other 20 sports, with 30% of the concussions in ice hockey resulting from a player being body checked.²⁰ Other estimates of the proportion of concussions resulting from being checked and/or delivering the check are as high as 30% to 70%.^{5–8} Concussion was reported as the most common specific injury type in Canadian minor boys' ice hockey, with a higher risk of concussion in age

groups that allowed legal body checking.¹⁵ Studies demonstrating an increased risk of injury related to body checking also demonstrated increased risk of concussion (Table 2). The meta-analysis by Emery et al of 4 studies estimated a combined odds ratio (OR) of 1.71 (95% CI 1.2–2.44) for body checking as a risk factor for concussion,¹⁷ whereas the prospective cohort study by Emery et al comparing Canadian provinces that allowed body checking in Pee Wee (11 and 12 years of age) boys' hockey found an IRR of 3.61 (95% CI 1.16–11.23) for severe concussion (more than 10 days lost from sport).¹⁶

Recent research has suggested that body collisions may have adverse effects without causing frank concussion. Studies using in-helmet accelerometers showed that exposure to repetitive head impact sustained by collegiate football and ice hockey players was associated with significant declines on neuropsychological cognitive testing compared with non-collision collegiate sports athletes over 1 playing season, independent of concussion diagnosis.²¹ Using similar technology, female intercollegiate ice hockey players, who are not allowed to check, sustained less frequent and lower magnitude head impacts than their male counterparts.²² This nascent area of investigation raises the concern that even early recognition and proper management of concussion—

a form of tertiary injury prevention—may be inadequate protection for the central nervous system.

Risks of "Aggressive Playing Style"

Body checking is associated with a more aggressive style of play, and aggressive play is associated with more severe injury. Players in leagues in which body checking is allowed have been shown to have lower levels of empathy, to have higher levels of aggression, and to respond more positively to statements about injuring another player with a body check to increase their team's chances of winning as well as body checking an opposing player even if they knew it would injure the other player.²³ A study examining rule infractions from 55 games at the Bantam level in 2 Canadian provinces revealed that illegal collisions or infractions, categorized as boarding, charging, checking from behind, elbowing, and intentional head contact, resulted in higher linear head accelerations and more severe head impacts than legal collisions.²⁴ More frequent and higher-intensity physical contact occurs in leagues that allow body checking.²⁵ An aggressive style of play (such as lunging or launching at the opponent) to ensure physical contact with disregard for the location of the puck has been observed in players at the Bantam level.²⁶ These data suggest that delaying body checking until later ages may also reduce aggressive play overall, which could lead to an even greater reduction in injury rates.

RISK OF AGE, SIZE, OR MATURITY DISCREPANCY

The 2000 AAP statement expressed concern that large discrepancies in relative age, size, and maturity may lead to an increased injury rate in those who are younger, smaller, and less physically developed. Most studies

that have examined age as a risk factor have found that older relative age, not younger, is associated with a higher rate of injury, particularly at higher levels of competition.^{27,28} It has been suggested that in these analyses, age was a proxy for magnitude or intensity of exposure. In 2 studies that examined differences in injury proportions in players in their first and second constituent years within age categories, injured players were more likely to be in constituent year 2 in the Atom (7 and 8 years of age) and Pee Wee (11 and 12 years of age) divisions and in the highest level of competition.^{16,29} In contrast, Bantam (13 and 14 years of age) players in their first year have been determined to have an increased risk of injury.²⁷ This is likely because the Bantam level contains the broadest range of physical maturity and body size.

Although the few studies that have examined the association between injury risk and physical maturity, as determined by Tanner staging, bone age, or other noninvasive measures, also have suggested that more advanced players sustain more injuries, there is no research examining the risk of injury attributable to athletes of discrepant maturity status directly competing and potentially colliding.^{30,31} Nonetheless, the range of physical development represented in the 13- and 14-year-old Bantam age category, which spans the typical male peak height velocity at 13.5 years of age, is wide enough to cause concern, with the height and weight of male Bantam players reported to differ by as much as 41 cm and 48 kg, respectively.³² An anthropomorphic study of youth football players in Michigan demonstrated a mean weight of 38.6 kg and BMI of 17.5 kg/m² in 13-year-olds categorized as “late maturing,” and “early maturing” 14-year-olds had corresponding means of 77.3 kg weight and 26.6 kg/m²

BMI.³³ Pop Warner Youth Football addresses this issue by restricting players above certain size thresholds to specified positions on the field (offensive and defensive line) where high-speed collisions are less likely. In a single study, smaller Pee Wee (11 and 12 years of age, ≤ 37 kg) but not Bantam (13 and 14 years of age, ≤ 52 kg) youth hockey players have been determined to be at increased risk of injury, but the authors' chosen 25th percentile weight cut points may not have had adequate sensitivity.^{16,27}

SAFETY STRATEGIES IN YOUTH ICE HOCKEY

Protective Equipment

Ice hockey players wear head-to-toe protective equipment. Although studies proving the merit of most of the gear is lacking, the speed of the puck and the use of curved sticks support its continued use. The piece of equipment that has generated the greatest controversy has been the helmet and facemask. Although some manufacturers have claimed protection from concussion for their particular models, no helmets have demonstrated evidence of such effect. Nonetheless, it is worth reinforcing that investigators have consistently found the overall injury rate to be significantly lower in players with helmets and full-face shield protection.^{34–40}

Rule Changes and Enforcement

The Canadian Ice Hockey Spinal Registry identified mechanisms of catastrophic cervical spine injury in the 1980s.⁴¹ Decreases in the incidence of these injuries followed more stringent enforcement of rules to prevent checking from behind, particularly near or into the boards, in addition to educational interventions. For the

2012–2013 season, the National Federation of State High School Associations approved rule changes to further strengthen enforcement aimed at eliminating dangerous play in hockey games. Hitting an opponent from behind into the boards or the goal frame is now considered a flagrant violation resulting in a game disqualification. The 2010 Ice Hockey Summit on Concussion called for a zero-tolerance policy with regard to any contact to the head, whether intentional or incidental.⁴² Nevertheless, Emery and Meeuwisse reported in 2006 that 97% of body-checking-related injuries were sustained by a player receiving a check, but only 15% of these injuries resulted in a penalty.¹⁵

Coaching and Education

Programs in both the United States and Canada that have emphasized coach and player education to teach youth to keep their heads up, especially when they are about to receive a check, and to respect their opponents by not checking them from behind have also coincided with a decrease in the incidence of cervical spine injury. ThinkFirst Canada's SMART HOCKEY initiative and USA Hockey's Heads Up Hockey curriculum aim to apply similar techniques to concussion recognition and prevention, but the effectiveness of these programs has yet to be assessed. USA Hockey's American Development Model emphasizes skill and skating development free from fear of being body checked at younger ages, while implementing a progressive curriculum to teach proper body control, angling, and body contact, reserving body-checking skills until the 11- to 12-year-old age group.

Minnesota's Hockey Education Program was implemented in 2004 to provide safer and more enjoyable

participation through Fair Play, a program first introduced 2 decades ago, that rewards teams with good sportsmanship specifically by allowing them to earn additional points for receiving fewer penalties.⁴³ In a 1999 study, the injury rate was 5 times higher in games played without the Fair Play rules in a tournament of Minnesota high school–age community-based teams.⁴⁴ Unfortunately, a 2005 study evaluating the effectiveness of the fair play concept in Quebec reported no significant difference in the injury rate, with either delivering or receiving a body check the primary cause for almost half of the injuries.⁴⁵ Several other interventions to promote safer play in youth ice hockey implemented both before and since the 2000 AAP statement similarly lack evidence for effectiveness in reducing injury rates.⁴⁶

No Protective Effect of Earlier Introduction of Body Checking

Proponents of body checking suggest that earlier introduction of body checking will increase skill and decrease injury related to body checking in older age groups, but there is limited evidence to support this potential effect. Older players (14–15 years of age) from a Canadian province that allowed checking at a younger age demonstrated an increased odds of a checking-related injury (OR, 1.90; 95% CI, 1.36–2.66) compared with their peers in a province allowing checking for the first time.⁹ After a lowering of age classifications by Hockey Canada in 2002, injury rates among 10-year-old Squirts (body checking never allowed) and 12-year-old Pee Wees (body checking always allowed) in Alberta did not change, but 11-year-old Pee Wee players newly allowed to body check sustained a significantly higher number of injuries.⁴⁷ A

subsequent prospective cohort study of almost 2000 male players 13 to 14 years of age, comparing injury rates in those with 2 years of body-checking experience with those being introduced to body checking for the first time, demonstrated that the game-related overall rates of injury, concussion, and concussion with more than 10 days of time loss were not significantly lower in players with 2 years of body-checking experience.²⁷ The injury rate associated with body checking was higher than other mechanisms of injury, and the rate of injury from body checking was not significantly lower in the group with body-checking experience (IRR, 0.82; 95% CI, 0.59–1.15), although the risk of injury resulting in greater than 1 week of time loss from sport was 33% lower among players with 2 years of body-checking experience.

OFFICIAL POLICY OF MEDICAL ASSOCIATIONS REGARDING HOCKEY SAFETY

Since the 2000 AAP statement, the American Osteopathic Academy of Sports Medicine (2002), the Canadian Academy of Sports Medicine (2007), and the Canadian Pediatric Society (2012) have released position statements about injuries in youth ice hockey. USA Hockey raised the age of legal body checking in games from Pee Wee (11 and 12 years of age) to Bantam (13 and 14 years of age) for the 2011–2012 season subsequent to the 2010 Ice Hockey Summit, which called for postponing legal body checking in youth games until 13 years of age. State and local youth hockey associations can offer leagues without body checking—often called “recreational”—at all ages, but competition with high school and other elite hockey programs that may promise the potential for advancement to higher levels of ice

hockey, which typically sanction body checking, may make this option rare in many communities.

CONCLUSIONS

There is consistent evidence that body checking remains a significant risk factor for injury at all levels of boys' youth ice hockey. Concussion is a particularly concerning problem and is often the result of body-checking activity. Body checking can also be associated with more aggressive play that further increases the risk of serious injury. The delay of body checking to higher ages has been shown to decrease risk of injury in 11- and 12-year-olds. Although data for older boys is less extensive, it is reasonable to conclude that removing body checking would reduce injury rates and severity at all ages, particularly benefitting 13- and 14-year-olds, who may be more vulnerable because of wide discrepancies in physical maturity.

RECOMMENDATIONS

In the continued interest of promoting boys' youth ice hockey as a safe, life-long recreational pursuit, the AAP recommends:

1. Expansion of nonchecking programs for boys aged 15 years and older. Pediatricians should advocate for development of these programs in their communities and encourage their patients to participate in them.
2. Restriction of body checking in boys' ice hockey games to the highest competition levels (eg, AAA, AA, Tier I, Tier II), starting no earlier than 15 years of age. Body-checking skills could be taught in practices starting at 13 years of age for those players geared to elite participation.

3. Strict enforcement of zero-tolerance rules against any contact to the head, whether incidental or intentional.
4. Reinforcement of rules to prevent body contact from behind, particularly into or near the boards.
5. Continued emphasis on coaching and education to prevent body contact from behind.
6. More research into the effects of legal body checking, including specific attention to injury risk attributable to differences in size and physical maturity.

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