June 4th 2008

Dr. Anita Palepu and Dr. Stephen Choi,

Open Medicine

**RE**: Body checking at a younger age increases injuries among minor hockey players.

Dear Dr. Palepu and Dr. Choi,

Please consider the above captioned manuscript for publication in Open Medicine.

As Canada grapples with getting our population to be healthy and active, it is incumbent on us to consider the risks and benefits of staying active. Sporting activities are central in policies aimed at keeping people healthy and active. In Canada, ice-hockey is one of the most popular sports and recreational activities among children and youth, with more than half a million registered youth playing hockey each year over the last decade. Ice hockey is also one of the leading causes of sport-related, non-fatal injury in children and youth. The risks of injury in hockey are greater than the risks seen with basketball, soccer, or football. Available data indicate that minor hockey players (9-17 year olds) sustain 50% of all hockey-related injuries and that a very significant proportion of these injuries are related to body checking.

Our paper represents original research on this important public health issue, namely body checking injuries in hockey.

Ever since Hockey Canada lowered the permissible age of body checking to 9 years, a debate has ensued around the benefits of body checking in the sport and whether there is any value to the practice. Some have argued that body checking ought to be introduced into the game at as early an age as possible so that players will learn to give and receive a check properly. Others have argued that all that introducing body checking at earlier ages does, is increase the duration of risk exposure and increase the total number of injuries.

Our paper demonstrates that risks are increased by this early introduction. Combined with the work of others, the evidence suggests that there is actually no evidence to support the practice at all from a health perspective.

Publishing the work in Open Medicine would be an excellent means to advance the purpose of knowledge translation and would be consistent with the Open Medicine's practice to highlight important work in this area.

I certify that the work has not been submitted elsewhere. Michael Cusimano conceived of the project, assisted in obtaining the dataset, guided the analysis and revised drafts of the manuscript. Nathan Taback completed the statistical analyses and revised the manuscript. Ryan Hodgins assisted in the development and initial analyses and wrote the first draft of the paper. Tsegaye M. Bekele assisted in the analyses and the manuscript development and, Steven McFaull ensured

integrity of the data, guided analyses and participated in the revisions of drafts of the manuscript. All authors reviewed and approved of the final version of the manuscript.

Sincerely,

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# Body checking at a younger age increases injuries among minor hockey players

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**1**
**2ABSTRACT**


**Background:**

Despite the popularity of ice hockey in northern countries like Canada, it is a major source of injury for those who participate. Body checking is a leading cause of injury among minor hockey players. Since 1998, there has been heated debate regarding the value of body checking in youth hockey, after Hockey Canada made a rule change that introduced body checking for competitive players as young as 9 years.

The purpose of this study was to determine if lowering the legal age of body checking had an effect on the incidence of all hockey-related injuries in general and on injuries specifically related to body checking among Ontario's minor hockey players exposed to the rule change.

**Methods:**

This study is a retrospective case control study based on data collected through the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP). The study's subjects consisted of male minor hockey league players (6-17 years) who visited emergency departments of five hospitals (three pediatric and two general hospitals) in Ontario for hockey-related injuries during 10 hockey seasons (September 1994 to May 2004). Injuries were classified into *body checking* or *non-body checking* based on the narrative information provided by the player and/or caregiver during their visit to the emergency room. Injuries related to body checking that occurred after the rule change took effect, were compared to those that occurred before the introduction of the rule.

**Results:**

A total of 8,552 hockey-related injuries were reported during the study period. More than half (52.2%) of these injuries were attributable to body checking. The Odds Ratio [OR] of an ED visit due to a body checking injury among minor hockey players increased after the rule change compared to the pre-rule change (OR=1.26, 95% CI 1.16-1.38). Players in Atom Division, the division in which body checking was allowed during the 1998-99 hockey season, had the highest odds of injury (OR=2.2, 95% CI: 1.70-2.84). Minor hockey players also sustained more severe injuries since the introduction of the new rule.

**Conclusions:**

The younger the children exposed to body checking in hockey are, the greater the risk of injury. Findings of this study add to the growing evidence that body checking holds greater risk than benefit for youth and support widespread calls for the banning of this practice.



**Key Words:** body checking, ice hockey, sport, athletic injuries, and injury prevention


**Word Count:** 388 words

**Background**

Sports and recreational activities are desirable to keep populations healthy, active and free of chronic diseases associated with sedentary lifestyles. However, sports and recreation as currently practiced are one of the major causes of injuries among North American youth [1, 2]. Ten to nineteen year olds are reported to have the highest rate of sports and recreational-related injury hospitalizations [3]. It is precisely at this time, that a society that wants to keep its youth active and healthy, would institute measures to keep these same people engaged in active, healthy lifestyles. Unfortunately, many youth nowadays abandon activities like sports in favor of more sedentary, unhealthy lifestyles with subsequent weight gain and the initiation of chronic disease.

In Canada, ice-hockey is one of the most popular sports and recreational activities among children and youth, with more than half a million registered youth playing hockey each year over the last decade, with almost 40% from Ontario [4, 5, 6]. Ice hockey is also one of the leading causes of sport-related, non-fatal injury in children and youth [7]. The risks of injury in hockey are greater than the risks seen with basketball, soccer, or football [8, 9]. Available data indicate that minor hockey players (9-17 year olds) sustain 50% of all hockey-related injuries [10].

Body checking is the most common cause of all hockey-related injuries and in particular, the commonest cause of severe injuries such as fractures and traumatic brain injury [10-14]. Unfortunately, body checks from behind that send players head first into the boards are still a frequent cause of injury despite rules prohibiting this practice [12]. The

debate surrounding the value of body checking among Canadian minor hockey players has increased since the 1998-1999 hockey season, when Hockey Canada introduced a 5-year voluntary pilot program which lowered the legal body contact age from Pee Wee division (11 and 12 years [15]) to the Atom Division (9 and 10 years [16]). Proponents of the rule change argued and continue to argue that lowering the legal age limit for body contact would enable minor hockey players to learn how to properly receive and give a body check at an early age and this early learning and repeated reinforcement of proper technique would actually reduce injuries at an older age. The pilot program received approval from Hockey Canada in 2005 to continue beyond its initially planned five-year period. Most minor hockey leagues of Ontario implemented this pilot program in 1998-1999 while two leagues, the Ottawa District Hockey League (ODHL) and the Kingston Hockey League (KHL), joined the program during the 2001-2002 hockey season.

The purpose of this study is to examine available data on injuries among competitive minor hockey players in Ontario to determine whether body checking injuries have increased or decreased since the introduction of the rule that lowered the age for legal body contact. It will also examine if available data supports the claim that allowing body contact at an early age (i.e., Atom Division) reduces body checking injuries at an older age (i.e., in Pee Wee, Bantam, and Midget Divisions).

## Methods

This study is based on data from five Ontario hospitals, three pediatric (The Hospital for Sick Children (HSC), Children's Hospital of Eastern Ontario (CHEO), and Children's Hospital of Western Ontario (CHWO)) and two general hospitals (Kingston General Hospital (KGH) and Hotel Dieu Hospital (HDH)) participating in the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP). CHIRPP is a national surveillance system which collects data on injuries of people (mainly children) who visit emergency rooms of 14 hospitals across Canada. Information collected included: what the injured person was doing at the time, what actually caused the injury, the factors that contributed to the injury, the time and place the injury occurred, and the age and sex of the patient [17]. Although only selected hospitals report to CHIRPP, data collected through the program is reported to represent the general injury patterns observed among Canadian Youth [18, 19].

Study subjects were male patients between the ages of 6-17 years who visited emergency departments due to hockey-related injuries between September 1994 and May 2004 (10 hockey seasons). Female patients were excluded as the rule change by Hockey Canada was implemented among minor male hockey leagues. Patients from the province of Quebec who visited the Children's Hospital of Eastern Ontario were excluded based on their residence postal codes, as the rules and regulations of the Ontario Hockey Federation do not apply to Quebec hockey players.

Narrative description of injuries captured in the CHIRPP database under the variable 'What Happened?' was used to identify hockey-related injuries and to classify injuries into *body checking* and *non-body checking* using the methodology developed by McFaull [11]. Narratives that contained "check", "checked", "cross checked", "pushed from behind", "hit from behind", "was hit by other/another player", "got hit by other/another player", "hit against boards", "hit into boards", "hit by elbow", "elbowed", "hit by knee", "kneed", "body contact", "mis en échec", "heurté", and "plaqué" were classified as body checking cases and all other injuries were grouped as non-body checking injuries.

Four hundred and ninety one (491) hockey injuries with narratives containing "collision between players" or "collided with a player" were excluded because it was believed that these injuries could be checking or non-body checking and information contained in the narratives was not enough to conclusively determine whether these injuries occurred as a result of body checking or other mechanisms.

To assess the level of potential misclassification error that may arise, a 10% random sample of the data (855 injuries) was coded manually by one of the authors and agreement between the manual coding and the automated coding was compared. Only 30 injuries (3.5%) were misclassified and the agreement level between the automated and the manual coding was excellent ($\alpha$= 0.93, P<0.001). Players were then classified, based on their age and date of injury, into specific CHA divisions. For pre 2002-2003 hockey seasons, players were classified into minor division leagues as follows: Novice (8-9 years old), Atom (10-11 years old), Pee Wee (12-13 years old), Bantam (14-15 years old), and

Midget (16-17 years old). Due to the change in the age category of minor league divisions by the CHA, data for the last two seasons under consideration (2002-2003 and 2003-2004), players were classified according to the new CHA division groupings: Novice (7-9 years old); Atom (9-11 years old); Pee Wee (11-13 years old); Bantam (13-15 years old); and Midget (15-18 years old) [20].

Most minor hockey leagues in Ontario implemented the pilot program which lowered the legal age for body contact during the 1998-1999 hockey season while the Ottawa District Hockey League (ODHL) and the Kingston Hockey Leagues (KHL) joined the program during the 2001-2002 hockey season. Accordingly, injuries were categorized as pre-rule change if an injured player: 1) presented to any of the five Ontario Hospitals between 1994-1995 and 1997-1998 hockey seasons; or 2) presented to CHEO, KGH, or Hotel Dieu Hospitals between 1998-1999 and 2000-2001 hockey seasons. Conversely, injuries were classified as post-rule change if an injured player: 1) presented to HSC and CHWO after the 1998-1999 hockey season; or 2) presented to CHEO, KGH, HDH in 2001-2002 or 2002-2003 or 2003-2004 hockey seasons.

Injuries were compared between cases (defined as visits by minor hockey league player to EDs as a result of hockey-related injuries from body checking) and controls (visits by minor hockey league player as a result of hockey-related injuries from mechanisms other than body-checking). The odds of sustaining body checking injuries are defined as the proportion of ED visits due to body checking related injuries to all

hockey related injuries after the rule change divided by the proportion of body checking injuries to all hockey related injuries before the rule change.

The study was approved by the St. Michael's Hospital Research Ethics Board. Statistical Analyses were performed using the SAS 8.0 system (SAS institute, Inc, Cary, NC). Odds ratio (OR) of sustaining body-checking injuries compared to non-body checking injuries were calculated using Mantel-Haenzsel $X^2$ statistics.

**Results**

The number of injuries reported from the five Ontario hospitals participating in CHIRPP during the study period is presented in Table 1. A total of 8,552 hockey related injuries (4.9% of all injuries) were reported among children aged 6 to 17 years. This translates into an average of 48.6 hockey-related injuries per 1,000 injuries of all types. More than half of all hockey related injuries (52.2%) reported to the study hospitals via CHIRPP during the study period were related to body checking. The number of body checking injuries fluctuated over the study period similar to the pattern of all hockey-related injuries. Due to the lack of data on the number of minor hockey players, it was not possible to determine whether the increase in the number of hockey-related injuries (or the increase in body checking injuries) was due to an increase in the number of players, the increase in the rate of injuries, or both.

**Table 1**. Hockey-related injuries among children aged 6-17 years
Ontario, 1994/95 – 2003/04

| Hockey season | Hockey-related injuries | | All types of Injuries reported to CHIRPP | Number of hockey injuries per 1000 all injuries |
|---|---|---|---|---|
| | Body checking injuries | All hockey injuries | | |
| 1994/95 | 423 | 830 | 17,672 | 47.0 |
| 1995/96 | 376 | 795 | 16,849 | 47.2 |
| 1996/97 | 361 | 741 | 16,475 | 45.0 |
| 1997/98 | 416 | 815 | 16,302 | 50.0 |
| 1998/99 | 478 | 864 | 17,067 | 50.6 |
| 1999/00 | 479 | 906 | 17,885 | 50.7 |
| 2000/01 | 443 | 901 | 18,672 | 48.3 |
| 2001/02 | 458 | 907 | 19,079 | 47.5 |
| 2002/03 | 549 | 936 | 21,125 | 44.3 |
| 2003/04 | 477 | 857 | 14,858 | 57.7 |
| **Total** | **4,460** | **8,552** | **175,984** | **48.6** |

Source: Canadian Hospitals Injury Reporting and Prevention Program.
**Note:** 2003/04 season data is only until May, other seasons reported till August of that year.

The breakdown of body checking injuries by minor hockey league divisions is presented in Table 2. Overall, the risk of sustaining body checking injury has increased post-rule change in all Divisions (except the novice division in which legal body contact is still not allowed) compared to the pre-rule change period. However, in the atom division, the division where the rule change had the greatest effect, a significant increase in the odds of an ED visit due to a body checking injury was observed (OR=2.2, 95% CI [1.70-2.84]).

**Table 2.** Comparison of body checking injuries before and after the rule change categorized by minor hockey league division

| **Division and type of injury** | **Number of checking injuries** | | **Odds Ratio (95% CI)** |
|---|---|---|---|
| | **Pre-rule change** | **Post-rule change** | |
| Novice | 44 | 65 | 0.99 (0.63 - 1.57) |
| Atom | 158 | 243 | 2.20 (1.70 – 2.84)* |
| Pee Wee | 549 | 831 | 1.10 (0.94 – 1.30) |
| Bantam | 546 | 990 | 1.11 (0.95 – 1.29) |
| Midget | 320 | 714 | 1.23 (1.01 – 1.49)* |
| **All divisions** | **1,617** | **2,843** | **1.26 (1.16 – 1.38)*** |

* Significant at the 0.05 level (2-tailed)
Source: Canadian Hospitals Injury Reporting and Prevention Program

**Nature and Severity of Injuries**

Body checking injuries reported to CHIRPP and categorized based on nature of injury are presented in Table 3. Overall, fracture (excluding tooth, including spine) was the most common type of injury, followed by sprain or strain (including upper and lower back) and superficial injuries (excluding eye). The odds of an ED visit due to a severe body checking injury such as an open wound, excluding eye (OR=1.33, 95% CI [0.93-1.91]), a minor head injury (OR=1.24, 95% CI [0.92-1.67]), and a sprain or strain, including upper and lower back (O.R. = 1.16 (95% CI [0.97 – 1.38]) increased significantly after the introduction of the rule, compared to the pre-rule change period. The odds ratios of other injury types (except for injury to internal organs) have not declined but have remained stable.

**Table 3.** Body checking injuries, proportion by selected natures of injury
Ontario, 1994/95 – 2003/2004 hockey seasons

| Nature of Injury | Number of body checking injuries (proportion of total hockey injuries) | | | Odds Ratio (95% CI ) |
|---|---|---|---|---|
| | Pre-rule change n (%) | Post-rule change n (%) | Total n (%) | |
| Superficial Injuries, excluding eye[1] | 506 (43.8) | 300 (45.8) | 806 (44.6) | 1.05 (0.85 - 1.20) |
| Open wound, excluding eye[2] | 66 (27.5) | 110 (37.3) | 176 (32.9) | 1.36 (0.93 – 1.91) ** |
| Fracture, excluding tooth, including spine | 458 (56.8) | 756 (57.4) | 1214 (57.2) | 1.01 (0.88 - 1.18) |
| Dislocation; including subluxation, spine | 67 (72.8) | 106 (63.9) | 173 (67.1) | 0.88 (0.4 - 1.1) |
| Sprain or strain, including upper and lower back | 310 (48.2) | 485(56.1) | 795 (52.7) | 1.16 (0.97 - 1.38) ** |
| Injury to Muscle or tendon [3] | 14 (46.7) | 98 (51.6) | 112 (50.9) | 0 (0.5 – 1.95) |
| Injury to internal organ | 8 (80.0) | 12 (66.7) | 20 (71.4) | 0.69 (0.29 – 3.15) |
| Soft Tissue injury | 4 (26.7) | 408 (47.9) | 412 (47.5) | 1.73 (0.58 – 5.21) |
| Minor Head Injury | 87 (52.7) | 287 (66.4) | 374 (62.6) | 1.24 (0.92 – 1.67)** |
| Concussion | 56 (63.6) | 212 (71.4) | 268 (69.6) | 1.05 (0.72 - 1.52) |
| Minor head injury & concussion (combined) | 143 (56.5) | 499 (68.4) | 642 (65.4) | 1.17 (0.93 – 1.48)** |

[1] Includes bruises, abrasions, irritation of skin and mucous membranes
[2] Including minor cuts, lacerations, punctures and penetrating wounds
[3] Including severing and rupture and excludes sprain or strain
** Statistically significant at the 0.05 level (2-tailed)
Source: Canadian Hospitals Injury Reporting and Prevention Program

**Body Part affected**

The most common body parts affected as a result of body checking injuries were the shoulders and arms, followed by head, neck, hip and leg (Table 4). The odds of an ED visit due to an injury related to body checking increased in most body parts (except to the hip and leg) after the rule change. The proportion of injuries associated with body checking to the head and neck increased significantly by approximately 40% (OR=1.52, 95% CI [1.26 -1.84]) following the lowering of the legal age for body contact.

**Table 4.** Number of body checking injuries categorized by body part affected (1994/1995-2003/2004)

| Body Part | Number of injuries | | Odds Ratio (95% CI) |
|---|---|---|---|
| | Pre-rule change | Post-Rule change | |
| Head and neck | 342 | 824 | 1.52 (1.26 - 1.84)* |
| Spine and/or Spinal cord | 17 | 24 | 1.18 (0.41 - 3.34) |
| Trunk | 172 | 297 | 1.30 (0.98 - 1.73) |
| Shoulder and arm | 797 | 1287 | 1.18 (1.04 – 1.35)* |
| Hip and Leg | 256 | 356 | 1.04 (0.86 – 1.27) |
| Others** | 33 | 55 | |

* OR significant at the 0.05 level (2-tailed).
** Includes multiple injuries of more than one body part, systemic injury, and unspecified body parts.
*Source:* Canadian Hospitals Injury Reporting and Prevention Program

**Table 5.** Summary of Regression Results

| Variable | Crude estimates | | | Adjusted* estimates | | |
|---|---|---|---|---|---|---|
| | Odds ratio | 95% CI | p | Odds Ratio | 95% CI | 1p |
| **Period** | | | | | | |
| Pre-rule change (reference group) | | | | | | |
| Post-rule change | 1.26 | 1.16-1.38 | <0.001 | 1.22 | 1.11-1.33 | <0.001 |
| **Injury Severity** | | | | | | |
| Less severe (reference group) | | | | | | |
| Severe | 1.26 | 1.17-1.78 | <0.001 | 1.26 | 1.16-1.38 | <0.001 |
| **Hockey Division** | | | | | | |
| Novice (reference group) | | | | | | |
| Atom | 2.20 | 1.70-2.84 | <.001 | 1.61 | 1.24-2.08 | <0.001 |
| Pee Wee | 1.10 | 0.94-1.30 | 0.12 | 3.09 | 2.43-3.91 | <0.001 |
| Bantam | 1.11 | 0.95-1.30 | 0.11 | 2.85 | 2.25-3.61 | <0.001 |
| Midget | 1.23 | 1.01-1.49 | 0.02 | 2.84 | 2.23-3.62 | <0.001 |

## Discussion

In this study, almost half the injuries that occurred were attributable to body checking. The odds of ED visits due to a body checking related injury increased from

48% before the OHF lowered the legal age of body contact from Pee Wee to Atom, to 52% after the lowering of the body checking age. Players in the Atom division sustained a significantly higher number of body checking-related injuries after the rule change. The proportion of body checking to non-body checking injuries also increased slightly among players of Pee Wee, Bantam and Midget divisions.

The odds of sustaining Head injuries (including concussion) increased after the introduction of the rule that lowered the age for legal body contact. Although, it is not possible to ascertain that the increased odds of an ED visit due to a head injury is caused solely by the lowering of age for body contact, it is very likely that allowing body contact will increase collisions between players and, players and inanimate objects which may have led to an increase in head injuries.

A study by MacPherson *et al*. [21] compared body checking injuries among players aged 10 to 13 in Ontario to those of the Province of Quebec using emergency department visit data collected through the CHIRPP. Those authors reported that Ontario players in leagues where body checking was allowed suffered a significantly higher number of injuries in general and severe injuries such as concussion and fracture injuries in particular. Findings from that study also indicated that given that the risk of sustaining checking injuries were higher among Ontario minor hockey players (where body checking was introduced at a younger age) compared to Quebec players, there was no protective effect from learning to check earlier.

Another study [22] examined the effect of body checking injuries on injury rates among minor ice hockey players in the Capital Health Region of Alberta. Following the change in age classification by Hockey Canada in 2002, 10 and 11 year old children who played at the atom level (where body checking is prohibited) were placed in the pee wee division with 12-year-old players (where body checking is allowed). The authors reported a significantly higher rate of injuries sustained by 11-year old children playing at the pee wee level compared to the rate among players of the same age at the atom level. A two-fold increase in the rate of severe injuries was reported among players at the pee wee level compared to that of atom level players.

Montelpare *et al*.[23] conducted a three-year longitudinal study which compared injury rates among atom divisions of minor hockey leagues of the Ottawa District Hockey Association (where body checking is prohibited) and other minor hockey leagues within the OFH (where body checking is allowed) using injury claims reported to the CHA. They reported no difference in injury rates between the two groups overall, but a three-fold proportion of checking related injury in leagues that allow checking compared to leagues that did not allow checking.

Willer *et al*.[24] also reported an increase in body checking injuries among 9 year old minor male hockey players when body checking was introduced, and showed that for all ages between 9 and 14 years old, hockey leagues which allow body checking have higher rates of injury compared to leagues that do not allow body checking. Despite these results, however, the authors stated that body checking should be introduced at an earlier

age, attributing the results to a speculated increase in testosterone and aggression at these ages. Dryden *et al.*[25] calculated rate ratios for each age group (9-14 yr olds) in the Willer *et al*. study comparing the body checking and non-body checking teams. The analysis showed that for all ages, the body checking leagues always had higher rates of injury. The rate ratios (body checking vs. non-body checking) ranged from 2 to 10, clearly demonstrating that body checking increased the risk of injury at every age group [25]. It is clear that learning to body check at a younger age does not reduce a player's risk of injury; instead, it prolongs the exposure to risk.

The issue of body checking in ice hockey ultimately needs to be resolved by a weighing of the risks and benefits of the practice by all those with a stake in ice hockey and the health of children and youth. There is now a significant consensus among a number of research studies that body checking undoubtedly increases the numbers of injuries. The incidence of concussion and other injuries consistently increases with an increase in body checking experience, reaching its zenith at the elite levels in collegiate leagues and the NHL [26, 27, 28] and is associated with significant risk of fracture, [29, 30, 31] concussion [28, 32] and spinal injury [33]. Furthermore it has been shown by this study and others [21, 22] that lowering the legal age for body checking has resulted in an increased number of injuries. Despite the growing evidence showing detrimental effects of body checking, no evidence exists indicating that earlier exposure to body checking and earlier learning to give and receive a body check lowers subsequent risk of injury in hockey.

A Canadian sport policy was established several years ago by 14 governmental jurisdictions in Canada with the intent of having Canadians at all ages participate in sport [34]. The policy clearly sees sport as "a powerful vehicle for the enhancement of health, well-being, and community development" [34]. Our study and a multitude of others demonstrate the increased risks of lowering the age of body checking and the risks of body checking at all ages. In addition, given that the maximum rate of attrition from a sport like hockey is precisely at the age when injury risk rises dramatically, size differentials between players is greatest, and body checking is in "full swing" [31]. A recent report indicating that the body checking age will be raised to 11 years old in Ontario and Saskatchewan [35] will do little to resolve the issue. It is now abundantly clear that the risks of body checking far outweigh the benefits. The data clearly supports prior calls to ban this practice [13, 36]. Now is the time for leadership and rationale change in this sport in Canada.

More opportunities for high-skill level competitive play without body checking must exist for players far beyond the atom level. For those intending on exposing people to the detrimental effects of body checking, responsibility for the practice must be accepted and concerted multifaceted efforts aimed at better rules and enforcement must be made. These changes will require broadly based collaboration between all stakeholders with an interest in hockey, other sports, health, activity and safety.

**Limitations**

This study was based on injury data of players visiting emergency departments of hospitals participating in the CHIRPP surveillance program and did not include players who visited hospitals which did not participate in this surveillance program or who sought medical care from physicians' offices/clinics. The CHIRPP dataset used herein captures only those players who sustained relatively severe injuries who sought treatment in an emergency room. The large sample size and the study design, allowed us to calculate odds ratios, however, the number of minor hockey players was not available and hence it was not possible to calculate injury rates.

A limitation of the CHIRRP dataset is that specific age divisions and competitive levels of the players were not known and it was also not possible to tell if players were injured in non-OHF play such as high school hockey. However, other studies have shown that the risks in competitive play are higher than those in less competitive environments. There may also be an under reporting of injuries related to body checking because we included an injury as body checking related only if the text explicitly indicated that body checking was involved, however, an injury such as "injured arm after sliding into the boards" (after a body check) may only have been recorded as a collision with the boards.

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