Effects of Changing Body-Checking Rules on Rates of Injury in Minor Hockey

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KEY WORDS

child, hockey, injury, physical activity, sports, trauma

ABBREVIATIONS

CHIRPP—Canadian Hospitals Injury Reporting and Prevention Program

CI—confidence interval

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WHAT'S KNOWN ON THIS SUBJECT: Body-checking is a common cause of youth ice hockey injury, and debate surrounding the age at which body-checking should be permitted continues. The age limit for introduction of body-checking varies across the Canadian provinces and the United States.

WHAT THIS STUDY ADDS: Results of this analysis add to research surrounding the merits and dangers of introducing body-checking at an early age. Although players may experience increases in risk for injury, introduction and enforcement of new rules seem to have mitigated these risks.

abstract

OBJECTIVE: In this study we explored the effects of the 2002 rule change in Ontario minor hockey, in which body-checking was introduced at the atom (ages 9–10) instead of the peewee (previously ages 12–13) age level. It was hypothesized that the introduction of body-checking at younger ages would result in higher overall rates of injury to minor hockey players, with concomitant increases in neurotraumatic injuries.

PATIENTS AND METHODS: Participants included injured minor hockey players between the ages of 7 and 14 years in the Kingston area of Ontario, Canada. The Kingston sites of the Canadian Hospitals Injury Reporting and Prevention Program were used to identify injuries that presented to the only 2 emergency departments in this community. In our analyses, we compared rates and patterns of injury that required hospital-based emergency medicine care before (1997–1998 to 2001–2002 seasons) and after (2002–2003 to 2006–2007 seasons) implementation of the body-checking rule change.

RESULTS: Overall rates of injury to minor hockey players declined in the years after the rule change. Rates of injury attributable to body-checking, as well as the natures and anatomic sites of injury caused by body-checking, remained consistent in the 2 study periods.

CONCLUSIONS: In this historical study, we did not observe an increase in the overall rates of injury and concomitant neurotraumatic events. Increased enforcement of playing rules as well as temporal declines in emergency department use may have contributed to these findings. *Pediatrics* 2010;125:735–741

Ice hockey is considered to be a major North American sport, with >500 000 young players registered in Canada[1] and an equivalent number in the United States.[2] Combining skill, speed, and aggression, hockey is a fast-paced and physical sport that involves high levels of body contact[3] and has been associated with high rates of injury. Of particular concern are the high rates of concussion and other forms of traumatic brain injury that may be caused by the inertial effects of direct or indirect blows that result in sudden and accelerative forces.[4] Before the introduction of mandatory face masks in Canadian youth hockey in the mid-1970s,[5] head injuries accounted for at least 50% of all serious injuries. These types of injuries continue to be viewed as a priority problem.[6]

Body-checking is a common cause of youth ice hockey injuries including concussions and other forms of traumatic brain injury such as cerebral contusions and dural (epidural and subdural) hematomas. Body-checking is defined by Hockey Canada as "an individual defensive tactic designed to legally separate the puck carrier from the puck. The action of the defensive player is deliberate and forceful in an opposite direction to which the offensive player is moving."[6] There has been continual debate surrounding the age at which body-checking should be permitted in minor hockey (organized youth hockey, up to the age of 17 years in Canada). The lower age limit for introduction of body-checking varies across the Canadian provinces and the United States.[2,7,8] In the United States, for example, body contact is permissible at the peewee age level (ie, ≥11 years of age) regardless of competitive level. The American Academy of Pediatrics has recommended limiting checking in players younger than 15 years.[3] The Canadian Academy of Sports Medicine noted that serious injury in ice hockey begins to appear at the peewee level and continues to escalate in bantam-aged players. They have also asserted that body-checking should not be allowed because of the differences in body size between players.[9] The height and mass of bantam players can differ by as much as 41 cm (16.14 in) and 48 kg (105.6 lb), respectively.[10]

Before 2002, body-checking was introduced to 12-year-old minor hockey players at the peewee level in Ontario. In 2002, Hockey Canada realigned the age-level divisions of play and changed the division in which body-checking was introduced (atom instead of peewee). These rule changes effectively introduced body-checking 3 years earlier (age 9) than in previous years (age 12).[11] This change was controversial. In the 2008–2009 season, Hockey Canada revisited this rule change, and body-checking rules in Ontario minor hockey were introduced among 11-year-olds at the peewee level. This is still several years earlier than in provinces such as Quebec that introduce checking only at the bantam (13-year-old) division and, even then, only at the most elite competitive levels within this age division and not in the lower competitive groupings such as house leagues.

Proponents of body-checking say that it is an integral part of the game of hockey and that teaching the skill early prevents injuries in later years of play.[12] Opponents of body-checking for young children believe that it is the most common source of injury in hockey and maintain that it should only be introduced at representative (non–house league) levels at the bantam ages (13–14 years) or later.[7] The question around the "learning effect" has been discussed but no consensus has been reached.[8,12] The question remains: Does introduction of body-checking at an early stage prevent or reduce the overall number of injuries experienced by minor hockey players?

We had a unique opportunity to perform a historical study of this issue in a defined Canadian population whose injury experiences were tracked during this time of controversy. Using the Kingston sites of the Canadian Hospital Injury Reporting and Prevention Program (CHIRPP) surveillance system, we examined (1) the effects of the 2002 changes to body-contact rules in minor hockey on risks and patterns of injury in Kingston and (2) the effects of the same rule change on experiences with neurotraumatic injury during minor hockey in Kingston.

METHODS

Data Source

The CHIRPP is an ongoing injury-surveillance program in Canada.[13] When an injured person presents to the emergency department of a sentinel participating hospital, information on the event is collected from the patient and also abstracted from their emergency department record.[13] A national data set is maintained by the Public Health Agency of Canada.[13] Data collection began in 1990 and, since then, >1.5 million records have been collected nationally.[13]

Kingston is a Canadian city in eastern Ontario with a population of ~120 000.[14] Kingston has 2 major hospitals that participate in the CHIRPP: the Kingston General Hospital and the Hotel Dieu Hospital. Both hospitals have been enrolled since 1993. The catchment area for the 2 Kingston hospitals includes residents of the city of Kingston, as well as those of Frontenac, Lennox, and Addington counties.[15] The Kingston-area hospitals retain some unique characteristics relative to other hospitals involved in the CHIRPP. First, both hospitals with emergency departments in the city are involved, which allows for complete

community coverage. Second, given that the city of Kingston is >200 km (120 mi) from the next closest major populous city, it is very unlikely that anyone with a significant injury that required urgent medical care would travel beyond Kingston to receive this care.[15]

Subject Accrual

A CHIRPP record is created for all injured patients who present to the emergency departments of the 2 Kingston hospitals. At triage, patients or their guardians are asked whether they are there for care of an injury. If yes, a CHIRPP surveillance form is automatically generated as part of the registration process. Emergency department patient logs are reviewed daily to capture injuries missed during registration. In the event of a severe injury with which the patient is unable to fill out the forms, coordinating staff complete the record on the basis of information obtained from medical charts. Descriptions of the circumstances surrounding each injury are provided by the patient or guardian 85% of the time, and the remaining descriptions are abstracted from the medical chart, as available.[13]

Identification of Hockey Injuries

Records of all injuries experienced by boys between 7 and 17 years of age during the calendar years 1997–2007 were abstracted from the Kingston CHIRPP data set by the primary investigators. All injuries ($N = 2708$) that occurred in a "rink, arena, or hockey arena" and were coded as hockey-related injuries or included "hockey" in the injury description were identified. For verification purposes, staff at the CHIRPP national offices at the Public Health Agency of Canada duplicated this search.

The data set was refined further by limiting cases to on-ice injuries reported as occurring during a game, practice, or tryout. Records were excluded if (1) the patient was younger than 84 months (7 years) or older than 180 months (15 years) of age at the time of injury, (2) the patient was injured during the summer (May 1 through August 1), when minor hockey rules do not always apply, (3) the injury event occurred in a place other than a hockey arena (eg, public park, house, street, school, roadways), (4) the injury event occurred at an informal game (shinny, street, floor, or pond hockey, public skating), or (5) the injury occurred off the ice (eg, carrying hockey bag, cut by skate in dressing room). Because body-checking is not permitted during girls' ice hockey, injuries to girls were also excluded. Older players (aged >15 years) were not considered for 2 reasons: (1) some youths may have been playing in more competitive leagues (junior hockey) by the age of 16; and (2) the oldest youths who would have played their entire career after the rule change were only 14 years old at the time of analysis.

During the case-identification process, 150 cases were independently reviewed by 2 of the primary authors. The interrater reliability of inclusion and exclusion decisions was calculated. Inclusion and exclusion criteria were further refined, and this verification process was completed with an additional 250 cases. Agreement on these decisions was very high ($\kappa = 0.83$). We observed 2554 of 2708 cases that met the initial inclusion criteria; of these, 407 of 2554 (15.9%) were for a repeat visit for treatment of a different injury in the same player. These were treated as independent observations as long as each visit was for a different injury.

Data Abstraction

Descriptors available in the CHIRPP record included basic demographics (eg, age, date of injury), location of injury event, activity and circumstances that led to the injury, nature of the injury and body part injured, sport being played, intent, and patient disposition. Reviews of individual injury narratives were also performed to determine if the injury event was a consequence of body-checking.

Player Registrations

For each year of study, the number of players registered in Kingston Minor Hockey at each relevant age group was imputed from (1) Ontario Minor Hockey Association (OMHA) records of Kingston-area player registrations for the 2006–2009 seasons, available in total and according to age group,[16] and (2) Ottawa District Minor Hockey Association records of total minor hockey registrations for the region ("district K") within which Kingston was situated, available on an annual basis for the 1993–1994 through 2007–2008 seasons.[17] The OMHA maintains registration records for Kingston, although district K was part of the Ottawa District Minor Hockey Association during the study period. Within playing divisions defined according to age group, estimates were split between minor (younger) and major (older) players so that rates could be calculated for integer age groups.

Statistical Analyses

Rates of injuries per 1000 player-years were estimated by integer age groups for the playing season years before (1997–1998 to 2001–2002) and after (2002–2003 to 2006–2007) implementation of the body-checking rule change. Rates were estimated for all minor hockey injuries that were reported to emergency departments within the Kingston CHIRPP system and then for injuries resulting from body-checking alone. Confidence intervals (CIs) surrounding these estimates were based on standard methods. χ^2 tests were used to compare the na-

TABLE 1 Rates of Injury for 5 Seasons Before and After the Rule Change for All Hockey Injuries to Minor Players and Those Resulting From Body-Checking Identified in the Kingston CHIRPP Surveillance Initiative

Age, y	Before Rule Change			After Rule Change		
	No. of Injuries	Player-Years	Injuries per 1000 Player-Years (95% CI)	No. of Injuries	Player-Years	Injuries per 1000 Player-Years (95% CI)
All minor hockey injuries						
7	5	981	5.1 (0.6 to 9.6)	5	1047	4.8 (0.6 to 9.0)
8	8	981	8.2 (2.5 to 13.8)	11	902	12.2 (5.0 to 19.4)
9	33	2406	13.7 (9.1 to 18.4)	23	1283	17.9 (10.7 to 25.2)
10	50	1339	37.4 (27.2 to 47.5)	47	1283	36.6 (26.3 to 46.9)
11	68	1339	50.8 (39.0 to 62.6)	56	1428	39.2 (29.1 to 49.3)
12	140	1168	119.9 (101.3 to 138.5)	72	1428	50.4 (39.1 to 61.8)
13	142	1168	121.6 (102.9 to 140.4)	124	1246	99.5 (82.9 to 116.2)
14	194	1304	148.8 (129.4 to 168.1)	146	1246	117.2 (99.3 to 135.1)
Overall	640	10685	59.9 (55.4 to 64.4)	484	9863	49.1 (44.8 to 53.3)
Body-checking injuries only						
7	0	981	0.0 (0.0 to 0.0)	0	1047	0.0 (0.0 to 0.0)
8	1	981	1.0 (0.0 to 3.0)	1	902	1.1 (0.0 to 3.3)
9	6	2406	2.5 (0.5 to 4.5)	4	1283	3.1 (0.1 to 6.2)
10	10	1339	7.5 (2.9 to 12.1)	18	1283	14.0 (7.6 to 20.5)
11	13	1339	9.7 (4.5 to 15.0)	18	1428	12.6 (6.8 to 18.4)
12	56	1168	48.0 (35.7 to 60.2)	28	1428	19.6 (12.4 to 26.8)
13	47	1168	40.3 (29.0 to 51.5)	53	1246	42.5 (31.3 to 53.7)
14	67	1304	51.4 (39.4 to 63.4)	48	1246	38.5 (27.8 to 49.2)
Overall	200	10685	18.7 (16.1 to 21.3)	170	9863	17.2 (14.7 to 19.8)

tures and anatomic sites of injury reported before and after the rule change, first for all minor hockey injuries identified and then for those that explicitly involved body-checking.

RESULTS

Rates of hockey injuries to minor players reported at the 2 Kingston emergency departments were calculated for the years before and after the body-checking rule change and are listed in Table 1. Rates of injury to minor hockey players and body-checking injury increased with age in both time periods. Although slight increases in the rates of body-checking injuries can be observed for the 10- to 11-year-old age group after the rule change, overall rates of injury to minor hockey players and also hockey injuries due to body-checking were, in general, equivalent or even lower in the 5 years after the rule change. This was attributable to decreases in reported rates of injury in the older playing divisions, illustrated in Fig 1.

Tables 2 and 3 show the distribution of reported minor hockey injuries for the 2 periods according to the nature and anatomic site of injury, respectively. Proportions of injuries that involved potential neurotrauma and also fractures remained consistent before and after the rule change (Table 2). This was true for minor hockey injuries in total and for those that involved body-checking. There were no important differences in the distributions of injuries according to anatomic site observed between the 2 study periods (Table 3).

DISCUSSION

When to introduce body-checking into minor hockey is a controversial subject. There are 2 competing theories. Proponents for early introduction of body-checking argue that by teaching this skill early, injury experiences of minor hockey players will be minimized as these children grow and develop through the older playing divisions.[7] Opponents suggest that early introduction of body-checking will lead to an unnecessary increase in injury rates, particularly to vulnerable young players.[12] No clear consensus exists about what is best for the sport, and current debate surrounding the potential for sustaining injury among young players suggests that early introduction of body-checking to minor hockey does more harm than good.[18]

Because of the population-based nature of our hospital emergency department system in Kingston,[13] it was possible to test these 2 competing theories in an observational study that spanned the 5 seasons before and after the minor hockey rule change that permitted body-checking at the atom level (9 years of age). Our study had 3 major findings. First, overall rates of injury to minor hockey players (aged 7–14 years) who presented to a hospital emergency department declined after the introduction of the body-checking rule change in Kingston and its surrounding area. Second, although slight increases in rates of injury to minor hockey players (including those that resulted from body-checking) were observed for players aged 10 to 11 years, substantial declines in injury rates were observed in

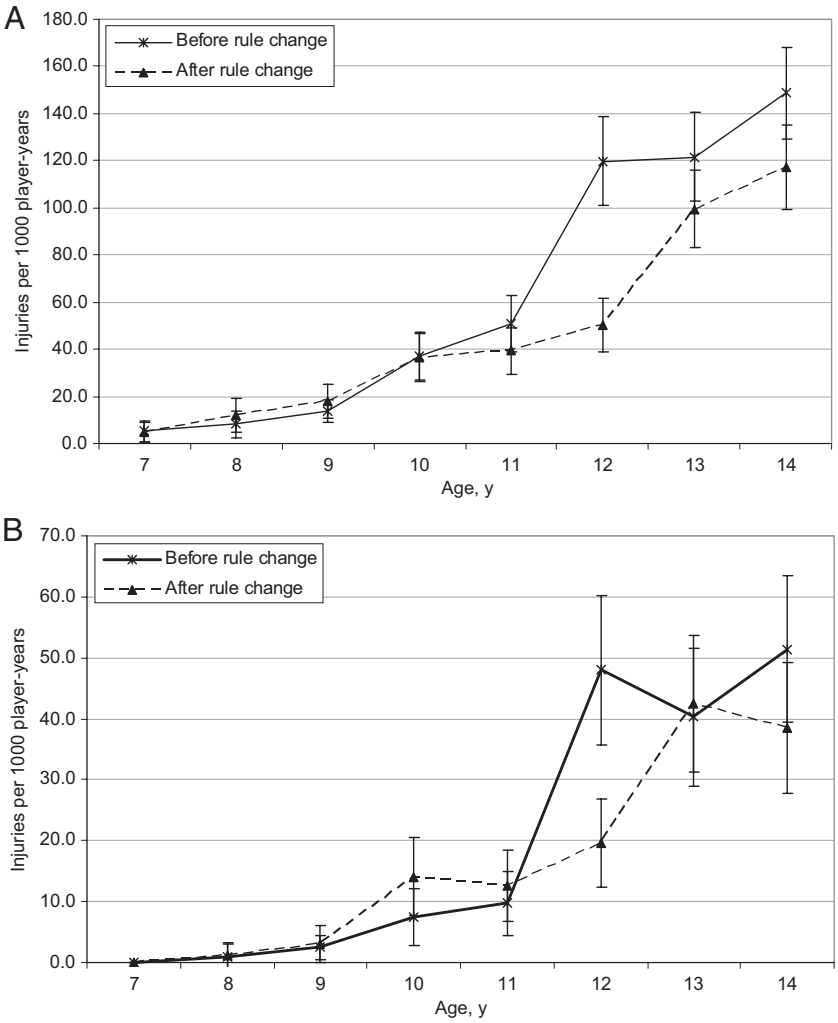

FIGURE 1

Rates of injury (with 95% CIs) according to player age in Kingston and its surrounding area for the 5 seasons before and after the 2002 rule change for all minor hockey injuries (A) and body-checking injuries alone (B).

the older age groups. Third, there were no statistically significant differences in the nature or anatomic sites of injury experienced in the 5 years before and after introduction of the rule change.

Our study findings, therefore, contradict the prevailing view that early introduction of body-checking to minor hockey is harmful to young players. In a recent systematic review, Warsh et al[18] synthesized evidence from 20 existing studies (12 descriptive and 8 analytic) that examined the injury experiences of minor hockey leagues that permitted body-checking at early ages. Body-checking was implicated as a major risk factor for injury in almost all cited studies. Of the 8 analytic studies identified, the evidence was mixed. Seven of these studies showed evidence of an increase in risk for injury associated with the early introduction of body-checking rules,[1,8,19–23] although Willer et al[20] suggested that the injury rate increase was short-term in nature. The eighth study, by Montelpare et al,[12] which was criticized for methodologic reasons,[24,25] compared the experiences from 1998–2001 in the Ottawa district (which permitted no checking) with those of the Ontario Hockey Federation (which permitted checking) and identified no increases in the incidence of injury. Our study findings are consistent with the findings and recommendations of Willer et al[20] and Montelpare[12] in that we observed a slight increase in rates of injury in some younger age groups, but these increases were counterbalanced by obvious declines in older age groups.

A number of additional factors may have influenced our results. First, introduction of the rule change was accompanied by major changes in enforcement of rules of the game that pertained to illegal contact,[12] including penalties and suspensions for checking from behind and blows to the head during competitive play. There were also teaching initiatives including coaching-certification courses (Hockey Canada) that covered body-checking rules and taught coaches about appropriate instructional techniques. Second, the injuries in this study represent those treated at emergency departments only, and there is the possibility of missed injury events that presented elsewhere for care. This would be unlikely to affect patterns of major injury that required immediate clinical intervention or radiologic screening, because these are only available in hospital-based environments in our setting. Third, the denominators used in this study, although the best estimates available, were imputed from division-specific counts of player registrations for our district obtained from the Ontario Minor Hockey Association and trends in player enrollment over time made available from the Ottawa and District Minor Hockey Association. Some inaccuracy in these estimates is inevitable, but they are generally consistent with player-registration trends in other parts of the country. In our analyses, we did not account for the fact that a

TABLE 2 Nature of Injuries in Minor Hockey in the 5 Seasons Before and After the Body-Checking Rule Change

Nature of Injury	Before Rule Change, Frequency		After Rule Change, Frequency		χ^2_1	*P*
	n	%	*n*	%		
All minor hockey injuries						
Sprains, strains, soft tissue injuries, open wounds	380	59.4	260	53.7	3.60	.06
Concussions, head injury	79	12.3	62	12.8	0.05	.82
Fractures and dislocations	154	24.1	132	27.3	1.50	.22
Other	27	4.2	30	6.2	2.24	.13
Total	640	100.0	484	100.0		
Body-checking injuries						
Sprains, strains, soft tissue injuries, open wounds	97	48.5	83	48.8	0.00	.95
Concussions, head injury	30	15.0	25	14.7	0.01	.94
Fractures and dislocations	61	30.5	51	30.0	0.01	.92
Other	12	6.0	11	6.5	0.03	.85
Total	200	100.0	170	100.0		

Cases were identified from the Kingston CHIRPP surveillance initiative.

TABLE 3 Anatomical Location of Injuries in Minor Hockey in the 5 Seasons Before and After the Body-Checking Rule Change

Location of Injury	Before Rule Change, Frequency		After Rule Change, Frequency		χ^2_1	*P*
	n	%	*n*	%		
All minor hockey injuries						
Head, neck, and spine	144	22.5	99	20.5	0.68	.41
Torso	74	11.6	35	7.2	5.90	.02
Upper extremity	276	43.1	235	48.6	3.28	.07
Lower extremity	137	21.4	105	21.7	0.01	.91
Other (unspecified or systemic injury)	9	1.4	10	2.1	0.72	.40
Total	640	100.0	484	100.0		
Body-checking injuries						
Head, neck, and spine	50	25.0	37	21.8	0.53	.47
Torso	32	16.0	17	10.0	2.88	.09
Upper extremity	93	46.5	91	53.5	1.82	.18
Lower extremity	22	11.0	23	13.5	0.55	.46
Other (unspecified or systemic injury)	3	1.5	2	1.2	0.07	.79
Total	200	100.0	170	100.0		

Cases were identified from the Kingston CHIRPP surveillance initiative.

portion of our district registrations are in the Church Athletic League (39% in 2006–2007) and 1 other former league in Kingston (percentage unknown), which did not permit body-checking and would remain unaffected by the rule change. Despite repeated attempts, it was not possible to obtain historic registration information specific to those leagues; therefore, it was not possible to account for any proportional changes in noncontact registration over time. Next, although the Canadian Academy of Sports Medicine has suggested that disparity in player height and weight may explain the increase in injury rates among bantam-aged players, we were unable to perform any analyses to this effect, because player height and weight data were not accessible to our research team through retrospective evaluation of electronic patient records. Future research should address this important factor. Finally, there are some intrinsic limitations to CHIRPP data. Emergency department injuries may be dissimilar to other injuries. Also, the system is based on self-reports from children, parents, and other caregivers.[13]

Major strengths of this study warrant comment. The injury-surveillance program in Kingston is unique to Canada in terms of its completeness and population-based nature. Second, we performed extensive reliability checks on the coding of the injuries under study, with excellent interrater agreement and confirmatory checks by national staff at the CHIRPP offices at the Public Health Agency of Canada. Third, information about the external causes and diagnostic properties of all injuries are centrally coded by trained program staff. This coding was performed independently of this particular study, because the CHIRPP is an ongoing surveillance effort with multiple applications for research and practice.[13]

CONCLUSIONS

The results of this novel analysis add to a growing body of evidence surrounding the merits and dangers of introducing body-checking to minor hockey at an early age. Frankly, the overall decline in rates of injury after the introduction of the rule change was unexpected. Our study findings suggest that minor hockey players who are introduced to body-checking at an early age may experience slight increases in risk for injury in younger age groups. However, speculatively, introduction of new rules and their enforcement seem to have mitigated any risks for injury that accompanied the body-checking rule changes in our communities.

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