Promoting respect for the rules and injury prevention in ice hockey: evaluation of the Fair-Play program

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Objective: To reduce the number of transgressions to the rule, the occurrence of violent acts and to prevent injuries, Hockey Québec adopted the Fair-Play Program (FPP). The objective of the present study was to evaluate the effectiveness of the FPP.

Methods: 52 Bantam (14-15 years) teams participated in this cohort study. In total, 49 games (13 with the FPP, 36 without FPP) were systematically assessed for transgressions to the rule. Body checking was allowed in all games. Transgressions to the rule data were obtained using a real time observation system in a natural setting, while injury data were collected through a self-administered questionnaire. Data were analysed using generalised linear models with generalised estimating equations accounting for potential team effect.

Results: The number of penalties per game was significantly lower ($p<0.01$) for games played with the FPP. Overall, no difference was noted in the number of transgressions observed during games played with or without the FPP. Players in leagues where the FPP was used held their opponents more frequently ($p<0.0001$). On the other hand, players in leagues without the FPP shoved and hit more ($p = 0.05$). No difference was noted in the injury rate for games played with or without the FPP.

Conclusions: This study showed that the FPP is one of the tools available to help those in the hockey world promote fair play values. Moreover, this project clearly showed the importance of program evaluation and the value of direct observation in a natural setting.

(J Sci Med Sport 2005;8:3:294-304)

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Introduction

In ice hockey, illegal behaviours penalised or not by referees are frequently identified as an important cause of injury[1,2]. Moreover, the increasing incidence of concussions[3,4] and the introduction of body checking at young ages are also subject to important controversy[3-6]. Hockey Canada defines body checking "as an individual defensive tactic designed to legally separate the puck carrier from the puck. This tactic is the result of a defensive player applying physical extension of the body toward the puck carrier moving in an opposite or parallel direction. The action of the defensive player is deliberate and forceful in an opposite direction to which the offensive player is moving and is not solely determined by the movement of the puck carrier."[7].

In response to these problems, Hockey Québec (the sport federation recognised by the Québec Government to promote and regulate ice hockey in

Québec) adopted the Fair-Play Program (FPP)[8]. This prevention program is aimed at reducing the number of penalties called by referees and, consequently, the occurrence of violent acts and the incidence of injuries. Similar rule modification programs showed some potential in reducing the rate of injuries in ice hockey and Australian Rules football[9,10].

In ice hockey, points awarded to determine the regular-season champions are traditionally based solely on the outcome of games. A victory nets the winning team two points, a tie game earns each team one point, and a loss means no points for the losing team. The way the FPP works is simple: each team can earn points for good conduct based on the number of penalty minutes called by referees. These points are added to the general standings after each game. For example, if a league's maximum number of penalty minutes is 14, a team that receives fewer than 14 penalty minutes during a game earns two extra points in the standings. That way, the winning team can earn two points for its victory and two extra points for sportsmanship, whereas the losing team can still earn two points for good conduct. No longer does the game's value depend solely on who wins or loses, but also on how the game is played.

One of the variables currently used to assess program effectiveness is the number and type of penalties per game[11-13]. This information is gathered from gamesheet reports (indirect data collection procedure). Assessment using gamesheet reports is useful, but has certain limits. It does not take into account all player transgressions to the rule, but only those called by the referee. Moreover, it is possible that the criteria used by the referee in his/her assessment of penalties may change during the course of a game[14]. Direct observation at games was thus chosen to reflect the reality of the sport as accurately as possible. Few programs designed to promote safety in sport and recreational activities have been systematically evaluated[15-17].

Objectives of the study

The general objective of the present study was to assess the effectiveness of the Fair-Play Program in Bantam level (14-15 years) leagues where body checking was allowed. More specifically, it sought to compare the incidence of transgressions to the rules and injuries, depending on whether or not the FPP was implemented.

Methods and procedures

Subjects and setting

Teams from one specific region of the province were studied. It was also decided to observe only games of the regular season. By doing so, it was possible to control for to potential confounding effect of the issue of the game.

In this study, 52 elite Bantam teams where body checking was allowed were studied. In total, 49 games (37 hr) were systematically assessed for rule transgressions. Since two teams were observed during every game, each team was observed 1.9 times on average. All games were played during the regular 2001-2002 season.

Design

Games were divided into two cohorts. One cohort of games where the FPP was

applied (N = 13) was compared to a cohort where the program was not applied (N = 36).

Variables measured and data collection procedure

Data were collected for two main categories of variables: transgressions to the rule and injuries. Transgressions to the rule data were obtained using a real time observation system, while injury data were collected through a self-administered questionnaire.

Transgressions to the rule

Defensive players use different individual tactics to stop the progression of the opponents and/or defend their territory. They can perform these individual tactics in conformity or in nonconformity with the rules. Based on Pfister studies, the term "adversary interaction" has been selected to describe the relation between offensive and defensive players[18]. "Interaction" refers to the rapport between teams in team sports, while "adversary" is used to define the notion of opposition[18].

An observation system was created based on the classification of adversary interactions in nonconformity with the rules (AINR) developed for soccer by Pfister and Avanzini[18,19]. This system was designed to operationalise the observation of ice hockey rules. The AINR are divided into *instrumental* transgressions tied to game play, and *non-instrumental* transgressions tied to players' emotional reactions (Table 1).

The observation system allows recording of a number of characteristics of the transgressions observed. The characteristics chosen for this study were the *nature* of the transgressions (eg, roughing, hitting, holding, hooking), the referee's decision (penalty or not), and the *level* of the transgressions. Level 1 is an "adversary" behaviour that bothers the opponent without real immediate effect, while level 2 is an "adversary" interaction which has a direct impact on the game and, in certain situations, may induce injuries.

Research assistants (RAs) had to participate at many supervised training sessions, composed of a video montage and live observations in game

Type of transgression	Function	Target	Nature	Examples
Instrumental	Oriented through the execution of the motor task	Opponent	Physical	Repulsion Retention Obstruction Percussion
Non-instrumental	Reactive, hostile, not oriented through the execution of the motor task	Opponent Referee Partner Self Object Public	Verbal Gestural Physical	Altercation Argument Insult Threat Roughing Hitting not during the action

* Adapted from Pfister and Avanzini[18,19]

Table 1: Classification of the adversary interactions in nonconformity with the rules (AINR).*

situations, in order to develop the validity and fidelity of their judgement. RAs had to analyse a video montage made up of 20 rule transgressions. Before being assigned to analyse a game, RAs had to have at least 18 good answers out of 20 (90%). The RAs were supervised by the principal investigator (PI) throughout the complete data collection process.

Compared with the referees on the ice, the observers could make better judgements of what was happening due to their heightened observation position in the stands. They had a better global view of the action on the ice. Their visual field was not obstructed by the players, or reduced by their height. In comparison, the officials on the ice have to observe the action and make judgements while skating and making sure that they do not collide with the players or disturb the development of the action. Moreover, RAs were not emotionally involved in the action. Therefore, their decisions were never criticised by the players, the coaches or the spectators.

For data collection, the PI selected games from the game schedules of the various leagues and assigned RAs. RAs were not informed ahead of time whether the FPP system was in effect. However, RAs may have been able to deduce whether the FPP was applied over the course of the game.

Injuries

A self-administered questionnaire was used to gather injury data. To be included in this study, the injury must have led players to seek medical advice or miss one game or one practice session on ice. Information on *when* the injury occurred, the *cause* of the injury, the duration of *activity limitation* due to injury, the *part of the body* affected and the *type* of injury were also gathered from the questionnaire.

At the end of the regular season, 600 questionnaires were distributed to players of 50 of the 52 teams observed. Coordinates of the persons responsible for two teams were impossible to find. After obtaining parental or guardian consent, players from each team completed the questionnaire and returned it to their coach in a sealed envelope. All signed consent forms were placed in a separate envelope from that containing the questionnaires. Two callbacks were made to coaches to optimise participation.

Data analysis

Outcomes such as transgressions or injuries were likely correlated within teams. Therefore, any presentation of confidence limits had to be adjusted for the clustering. Transgression and injury data were analysed using generalised linear models (GLM) with generalised estimating equations (GEE) accounting for potential team effect[20,21]. The GEE approach is an extension of GLM that allows the analysis of correlated data[22]. The correlation structure is considered to be a nuisance, which is accounted for by the method. Ignoring correlation often does not affect the estimates of the parameters in a model but leads to incorrect evaluation of their variability.

All analyses were conducted with SAS statistical software[23].

Results

Transgressions to the rule

A total of 8076 transgressions were recorded for games played without the FPP and 3195 for games played with the FPP. All 11 271 transgressions were fully

Type of transgression	No. of transgressions	No. of games	GEE* Adjusted Mean No. of transgressions per game (95% CI)	P
Instrumental	10,187	49	209.0 (199.5-218.6)	
Non-Instrumental	1,084	48	23.6 (20.3-27.0)	<0.0001
Instrumental-Level 1	6,064	47	129.5 (120.7-138.4)	
Instrumental-Level 2	3,818	49	77.8 (69.9-85.4)	<0.0001
Roughing and hitting	5,674	49	115.8 (107.6-124.0)	
Holding	5,337	49	108.9 (100.9-116.9)	0.30
Instrumental penalty	474	49	9.6 (8.6-10.6)	
Non-Instrumental penalty	82	48	2.3 (1.6-3.0)	<0.0001
Instrumental penalty-Level 1	146	49	2.9 (2.4-3.4)	
Instrumental penalty-Level 2	328	49	6.7 (5.7-7.7)	<0.0001

*Generalised Estimating Equation accounting for potential team effect

Table 2: Transgressions observed in regular season games.

analysed. An average of 230 transgressions to the rule were observed per game. Table 2 shows that instrumental transgressions were more frequent (adjusted mean number [AMN]= 209.0; 95% confidence interval = 199.5-218.6) than non-instrumental transgressions (AMN= 23.6; 20.3-27.0), and that Level 1 adversary interactions were more frequent than Level 2 adversary interactions. Instrumental penalties (AMN= 9.6; 8.6-10.6) were more frequent than non-instrumental penalties (AMN= 2.3; 1.6-3.0), and more Level 2 instrumental penalties were called than Level 1 instrumental penalties.

Overall, no difference was noted in the number of transgressions observed during games played with the FPP and without the FPP (Table 3). Level 1 adversary interactions were more frequent in FPP games (AMN= 145.6; 131.1-160.1) than in non-FPP games (AMN= 123.9; 111.2-136.0). Players in leagues where FPP was used held their opponents more frequently (AMN= 138.4; 130.7-146.0) than players in leagues without FPP (AMN= 97.1; 89.6-104.6). On the other hand, players in leagues without FPP shoved and hit more (AMN= 120.4; 110.8-130.0) than players in leagues with the FPP (AMN= 102.4; 88.1-116.7) (Table 3).

Overall, the number of penalties was significantly lower in games played with the FPP (AMN= 17.5; 14.6-20.4) than in games played without it (AMN= 22.2; 19.9-24.4). There were significantly fewer penalties for instrumental, non-instrumental and Level 2 instrumental transgressions called by referees in FPP games than in non-FPP games (Table 3).

Generally speaking, the referee penalised 9.1% of observed transgressions.

Injuries

In total, 333 questionnaires from players on 27 teams were collected. The response rates were 54% for the teams and 55.5% for players who agreed to participate. Complete data were obtained for 310 players.

Of all the players who completed the questionnaire, 57.4% (N= 178) of them have been injured during the 2001-2002 season. Of this number, 72.5% were injured during regular season games or championship games at the end of the

Type of transgression	Fiar-Play Program: No. of transgressions	No. of games	GEE* Adjusted Mean No. of transgressions per game (95% CI)	Non-Fair-Play Program: No. of transgressions	No. of games	GEE* Adjusted Mean No. of transgressions per game (95% CI)	P
All transgressions	*3,195*	*13*	*244.5 (299.9-259.2)*	*8,076*	*36*	*224.5 (210.3-238.6)*	*0.07*
Instrumental	2,865	13	217.5 (200.9-234.0)	7,322	36	203.2 (189.2-217.1)	0.23
Non-Instrumental	330	13	26.1 (21.5-30.6)	754	35	21.9 (18.3-25.5)	0.15
Instrumental-Level 1	1,739	12	145.6 (131.1-160.1)	4,325	35	123.9 (111.2-136.0)	0.03
Instrumental-Level 2	964	13	74.0 (61.6-84.5)	2,854	36	79.1 (68.8-89.4)	0.56
Roughing and hitting	1,335	13	102.4 (88.1-116.7)	4,339	36	120.4 (110.8-130.0)	0.05
Holding	1,808	13	138.4 (130.7-146.0)	3,529	36	97.1 (89.6-104.6)	<0.0001
All Penalties	*221*	*13*	*17.5 (14.6-20.4)*	*802*	*36*	*22.2 (19.9-24.4)*	*0.01*
Instrumental penalty	105	13	8.3 (6.9-9.6)	369	35	10.0 (9.0-11.1)	0.04
Non-Instrumental penalty	11	13	0.85 (0.52-1.15)	64	35	2.0 (1.7-2.3)	<0.0001
Instrumental penalty-Level 1	42	13	3.21 (2.7-3.7)	104	36	2.7 (2.1-3.3)	0.18
Instrumental penalty-Level 2	63	13	5.2 (4.0-6.4)	265	36	7.2 (6.1-8.3)	0.01

*Generalised Estimating Equation accounting for potential team effect

Table 3: Transgressions observed in regular season games according to the application of the Fair-Play Program.

season (N= 129). The other players were injured during on-ice practice (12.9%) or pre-game warmup (6.7%). The circumstances of how 14 subjects (7.9%) were injured were not known.

Because some leagues did not use the FPP during championship games at the end of the season, only the injuries suffered by 76 players during regular season play were analysed. We have also excluded injuries suffered during on-ice practice or pre-game warmup, as the FPP had no direct impact on these activities.

No difference was noted in the injury rate for games played with the FPP (adjusted rate [AR]= 0.97/100 player-game; 0.66-1.28) and those played without it (AR= 0.96/100 player-game; 0.67-1.24). The average duration of activity limitation was 16.5 days (9.35-23.7) with the FFP and 14.5 days (8.74-20.3) without it. The median was seven days for both groups. When both groups are considered together, most of the injuries affected the upper limbs (40.0%), and the most common injury was a muscle strain (Table 4).

An injury severity indicator was also created by grouping potentially

Body part	Type of injury	Fair-Play Program No.	Fair-Play Program %	Non-Fair-Play Program No.	Non-Fair-Play Program %	Total No.	Total %
Head and Neck	Fracture	0	0	2	4.4	2	2.9
	Cut or wound	0	0	1	2.2	1	1.4
	Concussion	1	4.0	4	8.9	5	7.1
	Contusion/bruise	1	4.0	0	0	1	1.4
	Other	1	4.0	0	0	1	1.4
	Total	**3**	**12.0**	**7**	**15.6**	**10**	**14.3**
Trunk	Dislocation	0	0	2	4.4	2	2.9
	Sprain	1	4.0	0	0	1	1.4
	Muscle strain	1	4.0	0	0	1	1.4
	Cut or wound		0	1	2.2	1	1.4
	Contusion/bruise	1	4.0	2	4.4	3	4.3
	Other	1	4.0	1	2.2	2	2.9
	Total	**4**	**16.0**	**6**	**13.3**	**10**	**14.3**
Upper Limbs	Fracture	2	8.0	2	4.4	4	5.7
	Dislocation	1	4.0	4	8.9	5	7.1
	Sprain	2	8.0	3	6.7	5	7.1
	Muscle strain	6	24.0	4	8.9	10	14.3
	Cut or wound	0	0	1	2.2	1	1.4
	Contusion/bruise	1	4.0	2	4.4	3	4.3
	Total	**12**	**48.0**	**16**	**35.6**	**28**	**40.0**
Lower Limbs	Fracture	0	0	1	2.2	1	1.4
	Dislocation	1	4.0	2	4.4	3	4.3
	Sprain	2	8.0	4	8.9	6	8.6
	Muscle strain	1	4.0	6	13.3	7	10.0
	Cut or wound	0	0	1	2.2	1	1.4
	Contusion/bruise	2	8.0	1	2.2	3	4.3
	Other	0	0	1	2.2	1	1.4
	Total	**6**	**24.0**	**16**	**35.6**	**22**	**31.4**
TOTAL		**25**	**100.0**	**45**	**100.0**	**70**	**100.0**

*Data missing for 6 cases

Table 4: Injuries according to the body part, the type, and the application of the Fair-Play Program.*

more severe injuries together. These injuries were fractures, dislocations, and concussions. Even if not significant, the risk of suffering one of these injuries appeared to be greater in games played without the FPP (OR= 2.43; 95% CI from 0.68 to 9.05). However, it should be mentioned that the small sample size greatly reduces the power of the results. They should therefore be interpreted with caution.

For both groups, the primary cause of injury reported was giving or receiving body checks (44.3%) and the secondary cause was colliding with the board (19.8%) (Table 5). When analysing paired causes most frequently named, body checking and collisions with the board were the two most strongly associated

Cause of injury	Fair-Play Program No.	%	Non-Fair-Play Program No.	%	Total No.	%
Collision with the board	9	20.9	12	19.1	21	19.8
Collision with a goal	0	0	1	1.6	1	0.9
Involuntary collision with a player	3	7.0	4	6.4	7	6.6
Body check (given or received)	20	46.5	27	42.9	47	44.3
Fall on ice	2	4.7	7	11.1	9	8.5
Hit by puck	3	7.0	1	1.6	4	3.8
Hit by stick	3	7.0	5	7.9	8	7.6
Hit by skate	0	0	1	1.6	1	0.9
Fight	1	2.3	0	0	1	0.9
Other	2	4.7	5	7.9	7	6.6
TOTAL	**43**	**100.0**	**63**	**100.0**	**106**	**100.0**

*Players could cite more than one cause; hence the total of 106.

Table 5: Cause of injury according to the application of the Fair-Play Program.*

factors. This is not surprising as body checking most often occurs near the board.

Discussion

In this study, 49 games were systematically observed. There is no reason to believe that this sample is not representative of the type of hockey played by elite Bantam ice hockey players in the province of Québec. But the limited number of games observed reduced the power of the analysis. Nevertheless, interesting significant differences were found between FP and non-FP games. More significant differences would have probably been revealed with a larger sample size.

It was interesting to note that transgressions differed depending on whether or not the FPP was applied. Players in leagues using FPP held more than players in leagues without FPP. This transgression often goes unnoticed by referees. Players may therefore have learned to circumvent the rules to hinder opponents without being penalised. Moreover, players who played without the FPP hit and shoved more. These behaviours could lead to severe injuries[1,3]. This could partly explain why the risk of severe injury was greater in leagues where the FPP was not applied. Again, it should be mentioned that the small sample size greatly reduces the power of the injury severity analysis. These results should therefore be interpreted with caution. Other studies are required to test these hypotheses.

Compared to gamesheet reports analysis, direct observation allows for more finely-tuned analysis of behaviours in game situation. If only gamesheet reports had been studied, the conclusion of this study would have probably been that the FFP had met all its goals by reducing the number of penalties assessed per game. Indeed, fewer penalties were called when the program was in place (- 21%). However, while the nature of the transgressions varied, their

number was the same whether the FPP was used or not. This questions program implementation process.

One of the key elements to be considered in order to implement such a program efficiently is the complete support of all the persons involved in the sport; that is, league administrators, players, coaches, officials and parents. The referees are not the only ones responsible for the implementation of the program. In fact, they are applying the decisions made by the administrators. Since the FPP modifies some important deep-rooted beliefs, referees have to be sure that everybody supports their decisions. If it is not the case, they could change their penalty-calling criteria depending on whether the game is played with or without the FPP. The results of this study did not allow a determination of whether or not this was the case. Once again, further studies are needed to validate this hypothesis.

Injury information was gathered through a self-administered questionnaire. To prevent possible recall bias by players of the FPP or the non-FPP groups, clear and precise operational definitions of the outcome (any injury that have led players to seek medical advice or miss one game or one practice session on ice) and of the exposure (participation in a regular season game) were used. Therefore, there is no reason to believe that a recall bias may have occurred.

The injury rate was the same for both types of games. The observation of the cause of injuries revealed that more than 60% of them were the result of a body check or collision with the board. These results support those of similar studies[5,6,24]. Here, body checking was allowed in all games studied. Therefore, there is every reason to believe that under these conditions the FPP had a limited impact on injury rates, as it does not directly target the main cause of injuries, namely body checking. The methodology used in this study did not allow testing this hypothesis. But Trudel and his co-workers suggested that the establishment of an intervention strategy aiming at the improvement of the teaching of good body checking techniques at Bantam level would have a very limited impact on injury prevention[25].

Conclusion

This project clearly showed the importance of program evaluation and the value of direct observation in a natural setting. It helped to shed light on the program's weaknesses from an implementation and application standpoint. It also allowed, among other things, to question the support offered to the referees. Further studies are needed to understand why the number of penalties called was greater when the FPP was not used, despite the fact that the number of observed transgressions was the same.

This study showed that the Fair-Play Program is one of the tools available to help those in the hockey world promote fair play in sport. However, it should not be seen as an end in itself. To be effective, the Fair-Play Program must be part of a broader project aimed at improving rule enforcement by officials, coaches' education and the promotion of healthy sport values among everyone involved in hockey; that is players, coaches, officials, league administrators and parents alike.

Acknowledgements

Funding for this project was provided by the Secrétariat au loisir et au sport of

the Government of Québec. We would like to thank Dr Brent Hagel for helpful comments on an earlier version of this manuscript, as well as Paul Villeneuve and Jean-Marc Daigle for their contribution to the statistical analyses. We would also like to underline the major contribution of Marc Beaudin who developed and implemented the Fair-Play Program in Québec.

References

1. Tator CH, Carson JD, Cushman R. Hockey injuries of the spine in Canada, 1966-1996. *Can Med Assoc J 2000*;162(6):787-788.
2. Watson RC, Singer CD, Sproule JR. Checking from behind in ice hockey: a study of injury and penalty data in the Ontario university athletic association hockey league. *Clin J Sport Med 1996*;6(2):108-111.
3. Marchie A, Cusimano MD. Bodychecking and concussions in ice hockey: Should our youth pay the price? *Can Med Assoc J 2003*;169(2):124-128.
4. Goodman D, Gaetz M, Meichenbaum D. Concussions in hockey: there is cause for concern. *Med Sci Sport Exerc 2001*;33(12):2004-2009.
5. Bernard D, Trudel P, Marcotte G et al. The incidence, types, and circumstances of injuries to ice hockey players at the bantam level (14 to 15 years old). In: Castaldi CR, Bishop PJ, Hoerner EF, eds. Safety in Ice Hockey: Second Volume, ASTM STP 1212. Philadelphia. *American Society for Testing and Materials 1993*:44-55.
6. Régnier G, Boileau R, Marcotte et al. Effects of body-checking in the pee-wee (12 and 13 years old) division in the province of Québec. In: Castaldi CR, Hoerner EF, eds. Safety in Ice Hockey, ASTM STP 1050. Philadelphia. *American Society for Testing and Materials 1989*:84-103.
7. Hockey Canada. Background on Checking. Available at www.hockeycanada.ca. Accessed January 18, 2005.
8. Marcotte G, Simard D. Fair-Play: an approach to hockey for the 1990s. In: Castaldi, CR, Bishop PJ, Hoerner EF, eds. Safety in Ice Hockey: Second Volume, ASTM STP 1212. Philadelphia. *American Society for Testing and Materials 1993*:100-108.
9. Roberts WO, Brust JD, Leonard B et al. Fair-Play rules and injury reduction in ice hockey. *Arch Pediatr Adolesc Med 1996*;150:140-145.
10. McMahon KA, Nolan T, Bennett CM et al. Australian rules football injuries in children and adolescents. *Med J Aust 1995*;159:301-306.
11. Cook DJ, Cusimano MD, Tator CH et al. Evaluation of the ThinkFirst Canada, Smart Hockey, brain and spinal cord injury prevention video. *Inj Prev 2003*;9:361-366.
12. Gilbert WD, Trudel P. A profile of rule infractions in bantam level ice hockey. In: Ashare AB, ed. Safety in Ice Hockey: Third Volume, ASTM STP 1341. West Conshohocken. *American Society for Testing and Materials 2000*:291-301.
13. Trudel P, Bernard D, Boileau R et al. The study of performance and aggressive behaviors of ice hockey players. In: Castaldi CR, Bishop PJ, Hoerner EF, eds. Safety in Ice Hockey: Second Volume, ASTM STP 1212. Philadelphia. *American Society for Testing and Materials 1993*:95-102.
14. Trudel P, Dionne JP, Bernard D. Differences between assessments of penalties in ice hockey by referees, coaches, players, and parents. In: Ashare AB, ed. Safety in Ice Hockey: Third Volume, ASTM STP 1341. West Conshohocken. *American Society for Testing and Materials 2000*:274-290.
15. Chalmers DJ. Injury prevention in sport: not yet part of the game? *Inj Prev 2002*;8(Suppl IV):iv22-iv25.
16. Emery CA. Risk factors for injury in child and adolescent sport: a systematic review of the literature. *Clin J Sport Med 2003*;13:256-268.
17. MacKay M, Scanlan A, Olsen L et al. Looking for the evidence: a systematic review of promotion strategies addressing sport and recreational injury among children and youth. *J Sci Med Sport 2004*;7:1:58-73.
18. Pfister R. L'agressivité et la violence dans le sport. *Études psychothérapiques 1989*; 20(3):209-213.
19. Avanzini G, Pfister R. Influence des punitions sur les comportements d'agression: étude de l'arbitrage des coupes du monde de football 1986 et 1990 STAPS - *Revue des sciences et techniques des activités physiques et sportives 1994*;15(35):7-17.
20. McCullagh P, Nelder JA. *Generalized Linear Models*, 2nd ed. New York, Chapman and Hall.

1989.
21. Hutchings CB, Knight S, Reading JC. The use of generalized estimating equations in the analysis of motor vehicle crash data. *Accid Anal Prev 2003*;35:3-8.
22. Liang KY, Zeger SL. Longitudinal analysis using generalized linear models. *Biometrika 1986*;73:13-22.
23. *The SAS system for Windows* [program]. 8.02 version. Cary, NC, USA, 1999-2001.
24. Mölsä J, Kujala U, Myllynen P et al. Injuries to the upper extremity in ice hockey - analysis of a series of 760 injuries. *Am J Sports Med 2003*;31(5):751-757.
25. Trudel P, Bernard D, Boileau R et al. Effects of an intervention strategy on body checking, penalties, and injuries in ice hockey. In: Ashare AB, ed. Safety in Ice Hockey: Third Volume, ASTM STP 1341. West Conshohocken. *American Society for Testing and Materials 2000*:237-249.