

Perceived Barriers to and Facilitators of an Injury Prevention Program Among Professional Male Ice Hockey Players and Staff Members

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Context: Injury prevention programs for the lower extremities are effective in team-sport athletes. **Objective:** To identify barriers and facilitators among professional ice hockey players and staff members for adhering to an injury prevention program. **Design:** Cross-sectional survey. **Setting and Participants:** A questionnaire about barriers and facilitators related to knowledge/perceptions, beliefs, adoption, and habits about injury prevention was filled out by Swiss professional male ice hockey players and staff members. **Main Outcome Measures:** Frequencies of ratings were calculated and binary logistic regression analysis was applied to predict a relationship between a high/low perceived benefit of an injury prevention program and player characteristics. **Results:** Knowledge, perceived benefit, and relevance of injury prevention as well as awareness of high risk of injuries in ice hockey were identified as important facilitators. Players' habit of exercise performance was identified as a barrier. Program understanding of staff members was identified as a facilitator and barrier. No significant relationships were observed between a high/low perceived benefit of an injury prevention program and age ($P = .85$), nationality ($P = .53$), level of education ($P = .63$), National League experience ($P = .50$), or occurrence of lower-extremity injuries in the previous season ($P = .10$). **Conclusions:** Players and staff members clearly rated perceived benefits of an injury prevention program, which can be considered an important facilitator of the uptake and adoption of such a program in ice hockey teams. Players should be educated about well-performed injury prevention exercises. Staff members should be educated about the aim of a regular injury prevention program. An injury prevention program might be implemented in players of all ages, levels of education, and experience in the National League, irrespective of previous injuries. Identified barriers and facilitators should be addressed when implementing an injury prevention program in a setting of professional ice hockey teams in the future.

Keywords: athletes, implementation, injury prevention exercises, perspective, preventative training programs

Ice hockey is a popular high-impact sport with a high risk of head and lower extremity (LE) injuries, mainly affecting the hip/groin/thigh and knee region.¹⁻⁵ Injuries can result in decreased sporting function, loss of playing time, high financial burden for the athlete's employer as well as the health care system, and an increased risk of reinjury and chronicity.^{5,6} Recent studies on musculoskeletal injuries showed that the majority of problems in ice hockey were of overuse origin, not leading to time loss but related to reduced self-reported function.^{4,5,7} Common extrinsic intervention strategies for players comprise tougher rules and regulations, rink adaptations, and equipment,^{2,8} yet intrinsic intervention strategies such as training—for example, muscular strength and endurance, range of motion, reaction time, and proprioception—are only rarely described for ice hockey.^{9,10} Only one study showed the effectiveness of a preseason exercise program to prevent adductor muscle strains in professional ice hockey players. Nevertheless there is still a lack of injury prevention research in ice hockey.⁹

To successfully implement injury prevention programs it is important to define an implementation strategy. For that to occur, the setting in which a program will be implemented needs to be explored. According to the social marketing theory,¹¹ uptake and

long-term adherence to an innovation, such as an injury prevention program, should not start with a final product, such as specific exercises for an injury prevention program. Instead, the current practice needs to be explored beforehand including analysis of (1) the current dryland training sessions, (2) target group(s) and their perceived barriers to and facilitators of the innovation, and (3) the context in which the innovation will be implemented.¹² This important step provides the basis to develop the implementation strategy for the innovation, which is based on different implementation activities.¹² The application of implementation science illustrates how sports injury prevention should incorporate these important concepts.^{13,14} Previous investigations examining the barriers and facilitators to implementing injury prevention programs in athletes have typically focused on athletes and/or coaches separately.¹⁵⁻¹⁷ Adoption is defined as the initiation of a program in a team setting, whereas adherence relates to the long-term extent to which a team implements a particular intervention as prescribed.¹⁸ Even though athletes are the end users and beneficiaries of prevention programs, the attitudes, knowledge, and beliefs of all staff members have greater influence than players' attitudes alone.¹⁵ One of the characteristics of professional ice hockey teams is that the head coach is merely in charge of the technical and tactical aspects, whereas other staff members (athletic trainers, sports physical therapists, and massage therapists) are dedicated to the fitness training and rehabilitation of the players. Thus it is important to assess barriers and facilitators for the uptake and adoption of a program among players as well as the staff members—not only coaches, but also athletic trainers and physical therapists.¹⁹

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This study aimed to identify barriers and facilitators among professional ice hockey players and staff members for adhering to an injury prevention program for the LE. It was hypothesized that players' characteristics were associated with a high or low perceived benefit of an injury prevention program and that time would be a major barrier for program adoption.

Methods

Questionnaire Design

The development of this questionnaire was based on a previous survey related to the implementation of an injury prevention program in Australian football players.¹⁷ Some of the questions were added based on social marketing strategies to explore the needs and culture of the target group.¹¹ All questions were adapted to ice hockey as well as formulated specifically for players and staff members. However, the questionnaire did not propose specific exercises because prior to the development of an injury prevention program it is important to obtain information about factors that may have an impact on the uptake and adoption of the program.^{11,17} The questionnaire comprised a total of 25 items about injury prevention for the LE^{2,3} over 4 categories: (1) knowledge/perceptions (definition and perceived benefits of injury prevention; 3 questions), (2) beliefs (about injury prevention; 13 questions), (3) adoption (initiation of a regular injury prevention program; 3 questions), and (4) habits (preferences of ice hockey players; 6 questions). The answer options to the questions were either multiple selection or single choice with answers ranging from "strongly disagree" to "strongly agree" on a 5-point Likert scale or open-ended questions. The preliminary version of the questionnaire was content- and face-validated by peer ice hockey players who were not involved in the study.²⁰

Participants

In total, 8 professional male ice hockey teams of the National League (NL) of the German-speaking part of Switzerland and their staff members, that is, athletic trainers, sports physical therapists, massage therapists, and assistant coaches, were invited to participate in the study and complete the questionnaire during the preseason period (August 2017). Inclusion criteria were the ability to understand German or English and a signed informed consent. According to the screening question during consent, none of the invited teams engaged in nor had a history in engaging in an injury prevention program use. The study was approved by the local ethics committee of the Canton of Zürich (ID number 2017-00085).

Data Collection

The questionnaire was completed by players and staff members of each participating ice hockey team during a summer dryland training session to reach the highest possible response rate. The questionnaire was administered to all players and athletic trainers, massage therapists, sports physical therapists, or coaches who were present on the specific test day. Information on player characteristics, that is, age, nationality, level of education, total NL experience, and LE injuries sustained in the previous season, was collected with additional questions. Study participants needed approximately 5 to 10 minutes to complete the questionnaire.

Data Analysis

Data were collected, stored, and managed in Microsoft Excel (Redmond, WA). Player and staff member characteristics are presented as frequencies (in percentages) or means with SD where appropriate. The frequency of ratings related to knowledge/perceptions, beliefs, adoption, and habits is reported as absolute numbers and percentages. Due to the relatively small sample size, all 5-point Likert scale variables were reduced to 3 levels (strongly/rather disagree, undecided, and rather/strongly agree). Two authors (R.B. and K.N.) independently allocated the most-rated items of the different categories with multiple selection options and Likert scale questions as facilitators of and/or barriers to adoption of an injury prevention program based on the description in a recent study²¹: (1) no evidence for influence on program implementation; (2) evidence of positive influence on program implementation, that is, a facilitator; (3) evidence of negative influence on program implementation, that is, a barrier; and (4) evidence of a mixed influence on program implementation, that is, a facilitator of and a barrier to program implementation. If the identification was unclear, consensus was either reached by discussion or with the help of a third reviewer (N.A.M.). To verify the hypothesis, that is, that player characteristics were associated with a high or low perceived benefit of an injury prevention program, the question "How much would you rate the benefit of an injury prevention program?" and the answers on a 5-point Likert scale were categorized into the variables "high" or "low" for further analysis. It was accounted for a potential clustering effect by teams. Binary logistic regression analysis was applied using PASW Statistics (version 18.0; SPSS Inc, Chicago, IL) with the level of significance set at $P < .05$ to predict a relationship between the perceived benefit (high vs low) of an injury prevention program and the following player characteristics as independent variables: age, <25 years versus >25 years; nationality, European versus North American; level of education, high (university degree) versus low (up to high school certificate); total experience in NL, <3 years (novice players) versus >3 years (experienced players); time-loss LE injuries versus no injuries in the previous season (self-reported by players). The outcome of the binary logistic regression analysis was identified as either a facilitator of and/or barrier to adoption of an injury prevention program.

Results

Participants

Out of the 8 professional ice hockey teams invited, 6 participated in the study (75%). The remaining 2 teams were unavailable due to their busy schedule or lack of interest. A total of 148 ice hockey players (98% response rate) and 11 staff members (92% response rate)—that is, 3 sports physical therapists, 3 massage therapists, 4 athletic trainers, and one assistant coach—completed the questionnaire. The characteristics of the participating players and staff members are presented in Table 1.

Player and Staff Members' Knowledge and Perceptions About Injury Prevention

Table 2 shows the ratings of the multiple selection questions of players and staff members in the category of knowledge/perceptions. The most-rated items to the question of injury prevention definition were: "prevention of injuries with specific training" rated

Table 1 Player and Staff Member Characteristics

Participants' characteristics	Players (n = 148)	Staff members (n = 11)
Age, mean (SD), y	26.5 (4.7)	41.2 (9.2)
Nationality, n (%)		
Swiss	111 (75)	6 (55)
Austrian	2 (1)	—
German	1 (1)	—
Dutch	—	1 (9)
Latvian	2 (1)	—
Swedish	7 (5)	—
Finnish	5 (3)	—
Czech	3 (2)	—
Italian	1 (1)	2 (18)
French	1 (1)	—
United States	3 (2)	—
Canadian	7 (5)	—
Others	5 (3)	2 (17)
Level of education, n (%)		
Compulsory school education	32 (22)	—
Completed professional apprenticeship	44 (30)	2 (18)
High school certificate/professional qualification	41 (28)	1 (9)
Higher education (eg, master craftsman examination)	5 (3)	1 (9)
University degree	23 (16)	6 (55)
Other	2 (1)	1 (9)
Level of experience in NL, n (%)		
<3 y	54 (37)	2 (18)
≥3 y	93 (63)	9 (82)
LE injuries in previous season, n (%)		
No injury	90 (61)	—
One or more injuries	57 (39)	—

Abbreviations: LE, lower-extremity; NL, National League.

by 95% of the players and 91% of staff members; “prevention of injuries as the most perceived benefit of an injury prevention program performed on a regular basis” rated by 81% of players and 82% of staff members; and “injury prevention as a preparation of the body for training” rated by 82% of staff members and 64% of players.

Overall, 78% of the players and 91% of the staff members agreed upon a moderate to high perceived benefit of an injury prevention program (Table 2).

Player and Staff Members' Beliefs, Adoption, and Habits With Regard to Injury Prevention

Table 3 shows the ratings of the items on the Likert scale of players and staff members in the category beliefs, adoption, and habits.

The items in the beliefs category with rather strong or strong agreement were: “prevention of injuries by following a specific exercise program” rated by 91% of both players and staff members; “the importance of injury prevention for playing at the NL level” rated by 86% of players and 91% of staff members; and “ice hockey has a high risk of injuries” rated by 82% of players and 100% of staff members. The item “every player is exclusively responsible

for injury prevention” was rated by 78% of players and 91% of staff members and “the trainers (off-ice/on-ice) are responsible for injury prevention with their training sessions” were rated by 41% of the players and 82% of the staff members. The item “an individual warm-up would be more useful than a standardized warm-up program with the whole team” was rated by 77% of players and 82% of staff members.

In the category adoption, 70% of players and 82% of staff members rather strongly or strongly agreed to the item “a standardised prevention program in form of a warm-up of 15 minutes at least 4 times per week is feasible” (Table 3). Thus, players and staff members both agreed to the uptake and adoption of an injury prevention program in their team.

The items getting rather strong or strong agreement by the players in the category habits were: “the players warm up before strength training” rated by 95%, followed by “it is important to the player that he carries out the exercises during the off-ice training correctly” and “the player assumes that his athletic trainer would inform him in the case that he performs an exercise incorrectly,” both rated by 94%. The items getting rather strong or strong agreement by the staff members in the same category were: “it is important to the player that he observes the correct posture in the

Table 2 Player and Staff Members' Knowledge and Perceptions of Injury Prevention

Knowledge/perceptions	Item rated as yes by players (n = 148)	Item rated as yes by staff members (n = 11)
Definition of injury prevention		
Prevention of injuries with specific training	141 (95)	10 (91)
Prevention of injuries with flexible boards	81 (55)	8 (73)
Prevention of injury with equipment	44 (30)	5 (45)
Prevention of injuries by implementing tougher penalties	23 (16)	4 (36)
Other: showing respect toward other players, massages and recovery time, complete preseason/ season dryland training, prevention of muscle imbalances that can cause problems, player education on regeneration and tissue repair, and individualization of the training program for each player	2 (1)	4 (36)
Perceived benefits of a regular injury prevention program		
Prevention of injuries	120 (81)	9 (82)
Preparation of the body for training	94 (64)	9 (82)
Improvement in flexibility	86 (58)	8 (73)
Improvement in strength	58 (39)	5 (45)
Better performance as a player	58 (39)	4 (36)
Improvement in balance	53 (36)	4 (36)
Safety, to avoid being injured	46 (31)	1 (9)
More interesting/good alternative to the normal warm-up procedure	21 (14)	1 (9)
Extent of perceived benefit of an injury prevention program		
High	35 (24)	4 (36)
Moderate	81 (55)	6 (55)
Undecided	28 (19)	—
Somewhat/very little	3 (2)	1 (9)

Note: Values are reported as numbers (%).

mirror during the training exercises" rated by all staff members, followed by "it is important to the player that he maintains the correct leg alignment during jump training" rated by 91% (Table 3).

Relationship Between Players' Perceived Benefit of an Injury Prevention Program and Characteristics

There was no significant relationship between a high or low perceived benefit of an injury prevention program and age ($P = .85$), nationality ($P = .53$), level of education ($P = .63$), NL experience ($P = .50$), or LE injuries in the previous season ($P = .10$).

Synthesis of Barriers to and/or Facilitators of Prevention

Table 4 provides a synthesis of items that have no evidence for influence on program adoption or act as either facilitator and/or barrier among players and staff members toward the adoption of an injury prevention program for the LE.

Discussion

This study aimed to identify barriers and facilitators among professional ice hockey players and medical staff members for adhering to an injury prevention program in professional ice hockey teams. The most prevalent facilitators for players and staff

members were the knowledge, perceived benefit, and relevance of injury prevention as well as awareness of high risk of injuries in ice hockey. Players and staff members clearly agreed with the benefit of such a program, which can be considered as an important facilitator of the uptake and adoption of an injury prevention program in professional ice hockey teams.

Agreement and Disagreement of Players and Staff Members Toward Injury Prevention

The players and staff members agreed or disagreed on several topics relating to injury prevention; these were identified as facilitators and/or barriers.

The identified facilitators are similar to the outcome of a survey with Premier Division Australian football players.¹⁷ These authors suggested that efforts aimed at educating players about the benefits of injury prevention programs were unnecessary¹⁷ because the players already had the knowledge about injury prevention. Moreover, knowledge does not automatically lead to a behavior change although it is an important requirement to take action.¹¹

The high importance of individualization of an injury prevention program for players and staff members is an essential facilitator for program maintenance. However, the individualization of an injury prevention program tailored to the needs of each player was reported to be rather unfeasible due to the lack of resources such as time for screening.²² It might be an option to include a compilation of different prevention exercises to allow individualization of the program, in order to further increase the chance of long-term

Table 3 Player and Staff Members' Beliefs, Adoption, and Habits With Regard to Injury Prevention

Beliefs/adoption/habits	Items rated by players (n = 148) in %			Items rated by staff members (n = 11) in %		
	Rather agree/ strongly agree	Undecided	Rather disagree/ strongly disagree	Rather agree/ strongly agree	Undecided	Rather disagree/ strongly disagree
Beliefs about injury prevention						
Injuries can be prevented by following a specific exercise program	91	7	2	91	9	—
Injury prevention plays a big role for the level of play required in the NL	86	11	3	91	—	9
Ice hockey has a high risk of injuries	82	18	1	100	—	—
Every player is exclusively responsible for injury prevention	78	15	7	91	9	—
An individual warm-up is more useful than a standardized warm-up program	77	20	3	82	18	—
The off-ice training prevents injuries	74	19	7	82	18	—
The on-ice hockey training is beneficial for the prevention of injuries	49	33	18	58	18	18
The trainers (off-ice/on-ice) are responsible for injury prevention with their training sessions	41	44	15	82	18	—
An injured player does not have to be completely rehabilitated to play ice hockey again	39	26	35	27	18	55
A guided injury prevention program in form of a warm-up with the whole team is useful	35	36	29	55	9	36
Training should additionally focus more on injury prevention rather than on ice hockey performance	13	43	44	9	36	55
Program adoption						
A standardized prevention program in form of a warm-up of 15 min at least 4 times per week is feasible	70	21	9	82	—	18
Mean maximum acceptable time to perform an injury prevention program in form of a warm-up on a regular basis, min		19.2			18.8	
Source of knowledge						
The current trainers/physiotherapists have passed on their knowledge to the players about injury prevention	64	27	9	91	9	—
The fellow players have passed on their knowledge to the players about injury prevention	33	50	17	55	18	27
Habits about exercise performance						
The players warm-up before strength training	95	5	1	55	27	18
It is important to the player that he carries out the exercises during the off-ice training correctly	94	4	1	82	18	—
The player assumes that his athletic trainer would inform him in the case that he performs an exercise incorrectly	94	5	1	18	45	36
It is important to the player that he maintains the correct leg alignment during jump training	85	11	2	91	9	—
It is important to the player that he observes the correct posture in the mirror during the training exercises	64	22	14	100	—	—
The player ensures that his posture is checked by fellow players during the training exercises	34	39	27	73	27	—

Abbreviation: NL, National League. Note: Values are reported as percentages unless otherwise indicated.

Table 4 List of Player and Staff Members' Barriers to and/or Facilitators of an Injury Prevention Program

Barriers and/or facilitators	Most prevalent items	Players	Staff members
No evidence for influence	<ul style="list-style-type: none"> • Time (ie, maximum acceptable time of 20 min to perform an injury prevention program) 	✓	✓
Facilitators	<ul style="list-style-type: none"> • Players characteristics (ie, age, nationality, level of education, NL experience, or occurrence of lower-extremity injuries in the previous season) • Relevance of injury prevention • Awareness of high risk of injuries in ice hockey • Knowledge about injury prevention • Perceived benefit of injury prevention program adherence • Responsibility as a player/trainer for injury prevention • Individualization of exercises • Program adoption 	✓	✓
Barriers	<ul style="list-style-type: none"> • Training sessions should not focus excessively on injury prevention • The athletic trainer is expected to provide feedback in case of incorrect exercise performance • Exclusive responsibility of players for injury prevention • Access to an athletic trainer for injury prevention 	✓	✓
Facilitator and barrier	<ul style="list-style-type: none"> • Injury prevention program to prepare the body for training 		✓

Abbreviation: NL, National League.

program adherence. Specifically, it has been demonstrated that strengthening and proximal control training including verbal feedback had a higher prophylactic effect on reducing anterior cruciate ligament injury risk in athletes.²³ Staff members should therefore choose appropriate exercises within those broader categories and tailor the exercises to individual needs.

Most of the staff members and some players believed that the athletic trainers were responsible for injury prevention during the training sessions. Thus, the athletic trainers facilitate program uptake as they play a major role in an injury program's initiation and delivery.¹⁵ Furthermore, an athletic health care provider likely has the most knowledge and experience to tailor and implement an injury prevention program. On the other hand, not having any/enough access to an athletic trainer could be a barrier for players.

The staff members and players agreed with the self-responsibility of players for injury prevention. This item was also identified as a facilitator for program uptake because awareness of responsibility is a precondition necessary to change a behavior.¹¹ However, this item can also act as a barrier for staff members, as they may consider themselves not responsible for injury prevention and neglect it.

Players expect athletic trainers to inform them if an exercise is not performed correctly. This can in turn act as a barrier for players to carefully perform prevention exercises and rely on their athletic trainers to perform the exercises correctly. Players' habits must be taken into account and can be improved by educating both program deliverers and players on the importance of maintaining proper technique and movement quality when performing injury prevention exercises.^{24–26} Interestingly, most of the staff members saw a benefit of a prevention program in preparing the body for training, which can facilitate adoption of preventive exercises, for example warming up before each training session. Performing prevention exercises in the form of a warm-up before training sessions is also based on current evidence.^{21,25} However, the program should not solely be seen as a preparation of the body for the actual training session, but rather acknowledged as injury prevention in general¹⁷

to increase awareness and appreciate its importance. This item was therefore identified to act as a facilitator for program adoption and as a barrier for program understanding. Staff members should be properly educated about the primary goal of an injury prevention program.

Players and staff members disagreed that training sessions should focus more on injury prevention, which is an expected finding in a performance-driven context like professional ice hockey. Less than 40% of the players perceived the benefit "to better perform as a player" when endorsing an injury prevention program. Players and staff members might not believe that injury prevention exercises enhance performance if there are no clear performance outcomes.¹⁷ Therefore, an injury prevention program should be quick and easy to perform before a regular training session and should be acknowledged as such.²⁵

Implications for the Implementation of an Injury Prevention Program

Time was expected to be a major barrier to perform an injury prevention program on a regular basis. However, based on our results, a program of maximum 20 minutes seemed to be accepted, which is in line with the recommendations by Padua et al.²⁵ The authors suggested a 15- to 20-minute time period to perform a multicomponent injury prevention program.²⁵ On the other hand, an exercise volume greater than 20 minutes is associated with a higher prophylactic effect.^{26,27} Thus, time was not considered a barrier to program implementation. Players and staff members rated a prevention program in the form of a warm-up of 15 minutes at least 4 times per week as feasible, which was therefore identified as a facilitator for program uptake and adoption. Nevertheless, the major challenge is long-term program adherence as described in previous investigations.^{28,29} The factors of age, nationality, level of education, NL experience, or occurrence of LE injuries in the previous season were not associated with a high or low perceived benefit of an injury prevention program; hence, players

characteristics were identified as having no evidence for influence on program adoption. This is an important aspect for future program implementation in Swiss NL teams and among players with different characteristics.

Limitations

The self-reported questionnaire was only face and content validated. It was, however, not tested for reliability because the study design is a cross-sectional survey and the questionnaire will not be used again. Moreover, the questions were based on a previous survey with the Health Believe Model³⁰ and the Reach, Efficacy/Effectiveness, Adoption, Implementation and Maintenance framework as theoretical basis.³¹ Another limitation was the low number of staff members and the fact that they included 4 different functions, that is, sports physical therapists, massage therapists, athletic trainers, and assistant coaches, resulting in limited generalizability of the findings. This limitation can only be addressed by increasing the total number of teams; however, this was not possible in the current study, which was limited to teams in the German-speaking part of Switzerland. The authors nevertheless think it is of great value to present staff members' knowledge, attitudes, and beliefs about injury prevention. Even though athletes are the end users and beneficiaries of prevention programs, the attitudes, knowledge, and beliefs of all staff members have greater influence than players' attitudes alone. Without that knowledge a program implementation in a team might not be successful because different barriers to and facilitators of program adoption and adherence might not be properly addressed.

Conclusions

This study has identified important perceptions of different team members that may act as barriers and/or facilitators to be taken into consideration when developing and implementing a LE injury prevention program in professional male ice hockey teams. An injury prevention program can potentially be applied with success in players of different age, level of education, and experience as well as in previously injured or noninjured players. Future studies should focus on developing an injury prevention program for the LE for ice hockey players and investigating the effectiveness of such a program.

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