Injuries and Risk Taking in Alpine Skiing


ABSTRACT: The purpose of this study was to investigate the relation between motivation toward alpine skiing, attitude toward risk-taking behavior, risk-taking behavior, and injury incidence. Participants were skiers over eleven years of age. They completed a questionnaire that investigated skill level, sources of motivation toward alpine skiing, attitude toward risk-taking behavior, and risk-taking behavior. A MANOVA was performed to compare three groups of skiers: (1) 163 skiers caught on the slope while performing a voluntary thrill-seeking behavior that could directly or indirectly lead to a sequence of events frequently associated to injuries (RISK TAKING); (2) 190 injured skiers (INJURED); and (3) 219 randomly selected skiers (UNINJURED). Significant differences were found between the three groups on age and skill level ($p < 0.001$). Skiers from the RISK TAKING group were younger (19.9 years old) than those from the INJURED group (24.7 years old) who were in turn younger than the UNINJURED group (30.7 years old). Skiers from the INJURED group were the least skilled, while those from the RISK TAKING group were the most skilled ($p < 0.001$). No differences were found between the INJURED and the UNINJURED groups on their source of motivation for skiing and their attitude toward risk taking. However, skiers from the RISK TAKING group were significantly different than the other two groups on those cognitive variables. They perceived the risky behaviors presented in vignettes as being less dangerous than skiers from the UNINJURED and the INJURED groups. These results suggest that in future prevention programs, the emphasis should be placed on the development of skiing technique among the low-skilled skiers. It also questions the strategy of targeting risk takers in prevention campaigns.

KEYWORDS: alpine skiing, motivation, attitude, risk taking, injuries

Alpine skiing is one of the most popular sports in the Canadian province of Quebec (population 7 million) with an estimated 800 000 participants, 92 centers in operation, and around 6 million ski days registered every year [1]. Unfortunately, injuries treated by a ski patroller on the slopes occur at a rate of 1.61 per 1000 ski days [2]. This places alpine skiing second only to ice hockey in terms of number of sporting injuries in Quebec [2].

It is suggested that the development of a tailor-made prevention program aimed at alpine skiers would make a significant contribution to the reduction of the burden of sport and

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recreational injuries in Quebec. Systematic planning of a skiing injury prevention program includes analyzing the magnitude of the problem and the behavioral risk factors, studying behavioral determinants, designing an optimal intervention, and implementing the intervention [3]. For most sports, there seems to be a strong need for further research on the etiology and determinants of behavior before effective prevention can be implemented [3].

In alpine skiing, as well as in many other sport and recreational activities, potential risk factors of injury can be classified into three main categories: (1) personal characteristics (physical fitness, skill level, age, gender, cognitive variables); (2) equipment (skis, boots, bindings); and (3) environment (climate, type of slope, snow conditions, slope design). In an activity such as alpine skiing, one might expect that risk-taking behaviors could be associated with injuries. Previous studies failed to associate sensation seeking with higher risks of injury [4,5]. The purpose of the study is to investigate the relationship between different sources of motivation toward alpine skiing, attitude toward risk-taking behavior, risk-taking behavior itself, and injury incidence. Examining these relationships could be helpful in the design of future prevention programs aimed at alpine skiers.

Materials and Methods

Subjects and Setting

Participants (n = 572) were skiers over 11 years of age (M age = 25.6 years old, SD = 11.9), recruited at six ski centers located in three different geographical areas in the province of Quebec (Canada) during the 1991–1992 season.

Design

Three experimental groups were constituted: (1) 219 randomly selected skiers (UNINJURED); (2) 190 injured skiers (INJURED); and (3) 163 skiers observed on the slopes while performing thrill-seeking maneuvers (RISK TAKING). The INJURED group included skiers treated by a ski patrol for an injury suffered on the slopes. Skiers in the UNINJURED group were selected at random at different periods of the week and of the season among skiers who had never suffered an injury during the ongoing season resulting in a medical consultation or a first-aid intervention. The RISK-TAKING skiers were caught on the slope while performing a voluntary thrill-seeking behavior that could directly or indirectly lead to a sequence of events that is frequently associated with injuries. The most often observed behaviors were “jumping” (29.2% of the observations), “skiing out of control” (23.7%), “skiing very fast in a crowded slope” (14.8%), and “skiing in a closed slope” (7%). “Jumping” was operationally defined as any action where a skier voluntarily takes advantage of the slope configuration to execute aerials or any other acrobatic maneuvers. Any situation where a skier is unable to control her/his speed or direction was defined as “skiing out of control.” The definition of “skiing very fast in a crowded slope” was: in a crowded slope, any situation where a skier voluntarily skis much faster than the general flow of skiers, and where she/he selects a course that does not ensure the safety of the other skiers. As for the UNINJURED group, the RISK-TAKING skiers had never suffered an injury during the ongoing season resulting in a medical consultation or a first-aid intervention. The data collection procedure is described below.

Variables Measured

Data were collected on the following variables: age, gender, skill level, sources of motivation for skiing (excitement, relaxation, mastering skills, social relations), attitude toward
risk taking, and risk-taking behavior. All data were collected through a validated self-administered questionnaire [6] sent to subjects.

Skill level—The subjects were asked to rate themselves in one of the five categories presented. Each skill level was operationally defined with a description of the skiing technique most often used to create a 5-point scale: “In which category would you rate yourself?” The choices offered were: (1) beginner: you are just starting to go down very easy slopes; (2) novice: you make all your turns in snow-plow on easy slopes (green circle); (3) intermediate: you are beginning to make parallel turns on difficult slopes (blue square); (4) advance: you are mastering parallel turns and you are at ease on difficult (blue square) slopes and some very difficult (black diamond) slopes; and (5) expert: you can ski on all types of slopes, in all types of conditions, with an excellent technical efficiency.

Sources of Motivation for Skiing—Twenty-six statements were used to measure the importance allocated by the subjects for each of the four sources of motivation studied. Seven statements were presented to estimate the motivation for “excitement,” eight for “mastering skills,” six for “relaxation,” and five for “social relation.” For each statement, the subjects had to rate their level of motivation on a four-point scale, graduated from 0 (“not important at all”) to 3 (“extremely important”). For example, one of the statements used to evaluate the level of motivation for excitement was: “I like skiing to face dangerous situations . . . .” Answers to the statements were averaged to compute the level of motivation for each source.

Attitude Toward Risk Taking—Seventeen statements were used to measure the subjects’ attitude toward risk-taking behavior. For each statement, subjects had to rate their perception of the dangerousness of the behavior presented on a four-point scale, graduated from 0 (“not dangerous at all”) to 3 (“extremely dangerous”). For example, one of the statements used was: “I consider making jumps in a crowded slope as . . . .” The attitude toward risk taking is the average score obtained for the 17 statements presented.

Risk-Taking Behavior—The same 17 statements used to measure the attitude toward risk taking were used to measure the frequency of risk-taking behaviors adopted. For each statement, subjects had to rate the frequency at which they adopt the risky behavior presented on a four-point scale, graduated from 0 (“never”) to 3 (“often”). The frequency of risk-taking behaviors adopted is the average score obtained for the 17 statements presented.

Data Collection Procedure

“Uninjured” Group—In each participating ski center, a research assistant was positioned at the main chalet and randomly selected skiers coming from the slopes. After confirming that the skier was 12 years old or more and had never suffered from a ski injury during the ongoing season, the assistant explained the objectives of the study to the skier and asked for his or her collaboration. If permission was granted, the name and address of the subject was noted so that the questionnaire could be mailed.

“Injured” Group—In order to respect the injured skiers, their collaboration to the study was not asked when they were being treated for their injury. The ski patroller would take the victim’s name and address on the injury report and then send the questionnaire to the victim. A consent form presenting the aim and the methods of the study was sent with the questionnaire. Therefore, the subjects could judge for themselves the legitimacy of the study and decide to participate or not. This procedure was done according to the protocol developed for this study and previously validated. Moreover, the methods used were approved by the Ethics Committee of the Université du Québec à Trois-Rivières, and respect the dispositions of two provincial statutes, that is An Act respecting safety in sports (R.S.Q., chapter S-3.1)
and An Act respecting access to documents held by public bodies and the protection of personal information (R.S.Q., chapter A-2.1).

"Risk-Taking" Group—Trained observers were positioned on the slope to identify skiers performing voluntary thrill-seeking behavior that could directly or indirectly lead to a sequence of events frequently associated with injuries. The observation stations were randomly selected, covering slopes from easy (green) to extreme (double diamond). As soon as the observer detected a "risk taking" skier, he/she followed the subject, and after confirming that the skier was 12 years old or more and had never suffered from a ski injury during the ongoing season, the assistant explained the objectives of the study and asked for his or her collaboration. Doing so, we removed the possible bias on attitude towards risk taking, which could come from having been injured. Moreover, the subjects were not informed of the reason why they were selected. If permission was granted, the name and address of the subject was noted so that the questionnaire could be mailed.

Data Analysis

Response rates were: 61% for UNINJURED, 56% for RISK TAKING, and 50% for INJURED. A $\chi^2$ was used to compare gender distribution among each group, and a MANOVA was performed to compare the group of skiers for each dependent variable measured.

Results

Gender Distribution—Significant group differences were found for gender distribution ($\chi^2(2) = 25.8, p < 0.001$). Women were over-represented in the INJURED group and under-represented in the RISK-TAKING group (Fig. 1).

Mean Age—Significant differences were found between the three groups on mean age (F(2546) = 45.7, p < 0.001; Table 1). Skiers from the RISK-TAKING group were younger (19.9 years old) than those from the INJURED group (24.7 years old), who were in turn younger than the UNINJURED group (30.7 years old).

Skill Level—Significant main effects were found for group (F(2566) = 45.2, p < 0.001; Table 1) and gender (F(1566) = 25.34, p < 0.001) on skill level (SL). Skiers from the INJURED group rated themselves as the least skilled (SL = 3.2), while those from the RISK-TAKING group rated themselves as the most skilled (SL = 4.1). On the other hand, men subjects rated themselves higher (SL = 3.9) than women (SL = 3.4).

![Diagram](image.png)

**FIG. 1—Distribution of subjects by gender among each group: $\chi^2(2) = 25.8, p < 0.001$**
TABLE 1—Mean age and skill level* of subjects among each group.

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<thead>
<tr>
<th></th>
<th>UNINJURED</th>
<th>INJURED</th>
<th>RISK TAKING</th>
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<tbody>
<tr>
<td>Age, years</td>
<td>30.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>24.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19.9&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Skill level</td>
<td>3.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.1&lt;sup&gt;c&lt;/sup&gt;</td>
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<sup>a</sup> Beginner, 1-2-3-4-5 Expert.  
<sup>b</sup> All groups are different for mean age (F(2546) = 45.7, p < 0.001).  
<sup>c</sup> All groups are different for skill level (F(2566) = 45.2, p < 0.001).

Sources of Motivation for Alpine Skiing—No differences were found between the INJURED and the UNINJURED groups on their sources of motivation for skiing (Table 2). However, skiers from the RISK-TAKING group were significantly different from the other two groups on those cognitive variables. They report “excitement” (F(2543) = 48.28, p < 0.001) and “social relations” (F(2544) = 9.07, p < 0.001) as being a more important source of motivation for skiing than INJURED and UNINJURED subjects. Skiing for its “relaxation” effect was more important for UNINJURED subjects than for the RISK-TAKING group (F(2545) = 6.23, p < 0.002). No group differences were found for the variable “mastering skills.”

Skiing for the “excitement” (EXT) it procures was significantly more important for the most skilled subjects (F(4543) = 39.26, p < 0.001; Fig. 2). Subjects of SL-4 (EXT = 1.5) and SL-5 (EXT = 2.0) consider this variable as more important than subjects of SL-1 (EXT = 0.6), SL-2 (EXT = 0.8), and SL-3 (EXT = 1.0).

Attitude Toward Risk Taking and Risky Behaviors Adopted—No differences were found between the INJURED and the UNINJURED groups on their perception of the dangerousness of the behaviors presented, as well as on the frequency of risky behaviors adopted (FRB; Table 3). However, skiers from the RISK-TAKING group were significantly different than the other two groups on those variables. They perceived the risky behaviors presented in vignettes as being less dangerous than skiers from the UNINJURED and the INJURED groups (F(2544) = 15.78, p < 0.001). RISK-TAKING subjects also report adopting the risky behaviors presented more often than the UNINJURED and INJURED (F(2539) = 39.10, p < 0.001). A skill level (F(4539) = 7.48, p < 0.001; Fig. 3), and a gender effect (F(1539) = 25.32, p < 0.001) were found. The highly skilled subjects (SL-4 and SL-5)

TABLE 2—Subjects’ level of motivation for skiing<sup>a</sup> by source of motivation among each group.<sup>b</sup>

<table>
<thead>
<tr>
<th></th>
<th>UNINJURED</th>
<th>INJURED</th>
<th>RISK TAKING</th>
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<tr>
<td>Excitement&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.2</td>
<td>1.2</td>
<td>1.8</td>
</tr>
<tr>
<td>Relaxation&lt;sup&gt;d&lt;/sup&gt;</td>
<td>2.1</td>
<td>2.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Mastering skills</td>
<td>2.1</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Social relations&lt;sup&gt;e&lt;/sup&gt;</td>
<td>1.4</td>
<td>1.6</td>
<td>1.7</td>
</tr>
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</table>

<sup>a</sup> Not important at all 0-1-2-3 Extremely important.  
<sup>b</sup> Scores underlined by the same line are not different at p < 0.05.  
<sup>c</sup> F(2543) = 48.28, p < 0.001.  
<sup>d</sup> F(2545) = 6.23, p < 0.002.  
<sup>e</sup> F(2544) = 9.07, p < 0.001.
reported adopting the risky behaviors presented more frequently than the least skilled subjects (SL-1 and SL-2), while men reported performing risky behaviors more often (FRB = 0.5) than women (FRB = 0.3).

**Discussion**

One of the strengths and originalities of the present study is that it allows comparisons between characteristics of skiers who were observed on the slopes while performing voluntary thrill-seeking behaviors with characteristics of injured skiers and a group of uninjured skiers. These data could certainly be helpful in the design process of future prevention programs aimed at alpine ski injuries.

As shown in other studies, men are more likely to demonstrate thrill-seeking behaviors than women [7–8], and injured skiers are less skilled than uninjured [9–11]. On the other hand, risk takers are highly skilled. Bouter et al. [4] and Cherpitel et al. [5] reported similar data where injured subjects scored lower on a sensation-seeking scale than did uninjured skiers. It is expected that higher-skilled skiers are also more experienced. As demonstrated in other activities, this combination of skill and experience probably helps the skier to better anticipate potentially dangerous situations and allows the selection of the appropriate motor response that will prevent the injury [12–16]. It could be that they are seeking risky situations more for the opportunity it gives them to test their ability than for the sake of coming close to real danger. Where a beginner (or a ski injury prevention specialist?) sees a danger, an experienced skier sees a challenge. Further researches are needed to test this hypothesis.

**TABLE 3—Attitude toward risk taking and risk taking behavior of subjects among each group.**

<table>
<thead>
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<th>UNINJURED</th>
<th>INJURED</th>
<th>RISK TAKING</th>
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</thead>
<tbody>
<tr>
<td>Attitude toward risk taking*</td>
<td>2.4</td>
<td>2.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Risk taking Behavior*</td>
<td>0.4</td>
<td>0.4</td>
<td>0.6</td>
</tr>
</tbody>
</table>

*Not dangerous at all 0-1-2-3 Extremely dangerous.

*Never 0-1-2-3 Often.

Scores underlined by the same line are not different at p < 0.05.

F(2544) = 15.78, p < 0.001.

F(2539) = 39.10, p < 0.001.
No differences were found between the INJURED and the UNINJURED groups as regard to their source of motivation for skiing and their attitude toward risk taking. However, skiers from the RISK-TAKING group were significantly different than the other two groups on those cognitive variables. They perceived the risky behaviors presented in vignettes as being less dangerous than skiers from the UNINJURED and the INJURED groups. This could be explained by their higher level of expertise, which allows the expert skiers to perceived situations differently.

Conclusions

Our results suggest that what characterizes the injured skiers is not that they take more risk or that they are more motivated by risky behaviors, but that they are less skilled. This implies that in future prevention programs, the emphasis should be placed on the development of skiing techniques among the low-skilled skiers. It is important to mention that it may not be important if the skier reaches the required skill level through formal ski lessons, through relatives teaching him or her, or through “natural ability” alone. Formal ski lessons should be viewed as part of an arsenal available to the skier to raise the level of skill [17]. It has also been suggested that to prevent injuries lessons should include more information on skiing safety in general [17] and more specifically on proper use and care of equipment and on proper falling techniques [18,19]. The results of the present study also question the strategy of targeting risk takers in prevention campaigns.

References


