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published in
Skiing trauma and safety: 8th International Symposium
1991

document version
Publisher's PDF, also known as Version of record

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Designing Effective Health Education for Downhill Skiers: Results of a Randomized Intervention Study

REFERENCE: Damoiseaux, V. M. G., de Jongh, A. M. L., Bouter, L. M., and Hospers, H. J., **"Designing Effective Health Education for Downhill Skiers: Results of a Randomized Intervention Study,"** *Skiing Trauma and Safety: Eighth International Symposium, ASTM STP 1104*, C. D. Mote, Jr. and Robert J. Johnson, Eds., American Society for Testing and Materials, Philadelphia, 1991, pp. 241–248.

ABSTRACT: This article presents the results of a randomized intervention study among Dutch downhill skiers of 18 years and older. The objective of the study was to find an effective method to convince skiers that they have to adjust their ski bindings adequately. Literature study revealed that adequate adjustment of bindings (that is, by an expert and by means of a test device) is the most important behavior that can be manipulated to decrease the occurrence of ski injuries.

Three conditions were varied: when (the "moment") information materials were sent to skiers (one week versus three weeks before departure on a ski vacation), the medium (cassette versus leaflet), and the approach (fear-arousing versus neutral information). In this way, eight experimental groups were composed. In addition, a control group was formed that did not receive any information. The effects of the three conditions on the following factors were measured: attention, comprehension, intention, and behavior.

The cassette received a higher degree of attention than the leaflet, irrespective of time or degree of fear. The level of comprehension was higher in all experimental groups than in the control group. The information sent long before departure and with a high degree of fear produced the most effect on the level of comprehension. As for the factors intention and behavior, no differences were found between the experimental groups and the control group. Differences in intention and behavior did appear among the distinctive experimental groups. The information sent shortly before departure as well as the information with a low degree of fear proved to have the least effect on intention. Behavior was most affected by information with a high degree of fear, irrespective of time and medium.

KEY WORDS: downhill skiing, ski bindings, health education, prevention, injury, evaluation

Only ten years ago in the Netherlands, skiing was primarily practiced by sports fanatics and people with heavy purses. Today, almost one million Dutch tourists every year travel to Austria, Switzerland, and France to go skiing, proving that the sport has developed into a national sport. Although it is believed that, in general, sports participation has a favorable effect on health, there are also some drawbacks: sports injuries constitute a serious demand

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on the financial resources of national health care and they often disturb social and economic functioning (for example, absenteeism).

Health education can focus on influencing human behavior to prevent such injuries. By intentional interventions, health education tries to eliminate those behaviors that threaten health and to promote factors that have favorable effects on health. Effective health education depends on systematic planning and evaluation [*1*]. This study deals with the design of health education for downhill skiers that aims at reducing the injury incidence. The results of this study will constitute the basis of a national campaign in the Netherlands.

There are numerous causes and risk factors of ski injuries. Most risk factors are relatively constant and hard to influence and therefore inappropriate as an object for health educational intervention. The only behavioral factor proven to be related to ski injury is the adjustment of ski bindings. Several authors stress the importance of good information on adequate adjustment of ski bindings [*2–6*]. In the past decades, the incidence of ski injuries has decreased, which is probably due to an increased attention to extrinsic causes, in particular technical improvements of skiing gear [*2,4*].

As early as 1976, Johnson observed a relation between binding adjustment and occurrence of ski injuries [*7*]. Evaluation of a Swedish intervention [*8*], in which skiers were given the opportunity to adjust their ski bindings adequately on the ski run, revealed that well-adjusted bindings increase by 50% the chance of release at the right moment, resulting in a decrease of more than 10% of lower extremity injuries. Several authors have confirmed these findings [*5,9*].

Only one study [*3*] dealt with determinants playing a role in behavior concerning adjustment of ski bindings. The real problem seems not to be the actual adjustment of the bindings—a majority of the bindings are adjusted—but rather the lack of knowledge of adequate and individual adjustment [*3*]. The best way to adjust the bindings adequately is with the help of experts and a test device [*10*]. Therefore, this study focuses on the design of effective health education with this message.

To find the most effective health education intervention, we varied three conditions:

1. *Medium*: leaflet versus cassette.

Little is known about the results of auditory information materials because they are rarely used. A majority of Dutch skiers travel to their winter sports destinations by car equipped with a cassette recorder, and, therefore, it is possible to play the cassette during the journey. Music, played at intervals during the message, was meant to increase its attractiveness.

2. *Moment of receiving*: one week versus three weeks before departure on ski vacation.

One important reason why information is not effective is that the message reaches the receiver at the wrong time. In this study, we varied the moments at which the information was conveyed, at an interval of two weeks, in order to detect the moment at which the receiver is the most receptive to the message.

3. *Approach*: fear-arousing versus neutral.

In our study, we varied the degree of fear-arousing information. In the version that aims specifically to arouse fear, we emphasized the seriousness of injuries and the vulnerability of the skier. In the other version, we tried to be as neutral as possible, giving information about ski risks without working on the persons's feelings (for example, "Do not be fooled, your own arms, legs, ribs, purse and vacation are at stake" versus "Do not be fooled, it is your own safety that is at stake").

Material and Methods

The central message of our intervention was: "Have your ski bindings adjusted in a ski shop with the aid of a test device." In composing the message, we aimed at a terse, brief,

and comprehensible formulation. We have, therefore, chosen items that are directly related to the adjustment of bindings:

- Effectiveness of adequate adjustment,
- Functioning of bindings and the necessity of individual adjustment,
- Disposal of possible misconceptions (for example, "rented skis are already adjusted"),
- Precautionary measures to profit optimally from the adjusted bindings (maintenance, transport),
- Possible barriers to the desired behavior (for example, cost of adjustment), and
- Inevitable risks of skiing.

The message was written by professional copywriters, subsequently pretested in the target audience, and criticized by communication experts and subject experts (ski instructors, ski shop employees, national ski federation members, and so forth).

To find the most effective communication method, we used a quasi-experimental study design [*11*]. By manipulating three independent variables on two levels, eight experimental groups were formed (Table 1):

- Medium (cassette versus leaflet),
- Moment (one week versus three weeks before departure), and
- Approach (fear-arousing versus neutral).

We also formed a control group of skiers who did not receive any information.

The study population included persons of 18 years and older who were recruited at ski fairs. Visitors of ski fairs were asked to take part in a telephone survey on the subject of skiing and safety. Adjustment of ski bindings was not mentioned. The 1380 people who agreed to take part in the survey were all planning to practice downhill skiing during the winter of 1987/1988.

Seventy respondents were pretested; 22 skiers did not comply with the inclusion criteria (for example, they were younger than 18 years or they were not going skiing) and were left out. Thus, the sample consisted of 1288 people; 136 were listed under the control group and the rest were divided into eight experimental groups, an average of 145 per group. These skiers were distributed at random among the conditions medium, moment of receiving, and approach, and subsequently received a leaflet or cassette before their departure.

TABLE 1—*Study design.*

Experimental Groups					
		Medium			
		Cassette		Leaflet	
	Time	1 week before departure	3 weeks before departure	1 week before departure	3 weeks before departure
Fear	high	message 1	message 1	message 1	message 1
	low	message 2	message 2	message 2	message 2
Control Group					
		no message			

The telephone survey was done after the skiers received a cassette or leaflet and after their ski vacations with the aid of an interactive computer-controlled interview system. The interviews were conducted over 22 days, in the afternoon and evening. The results were analyzed with the SPSS-X program [*12*].

Results

Response was very high (91.5%), which can be explained by the fact that the respondents had promised beforehand to cooperate in the survey. The response is well divided among the different groups, although the mean response for the experimental groups was higher (92.3%) than for the controls (83.8%). In comparing demographic and personal factors (for example, sex, age, and skiing experience) in response and nonresponse, and in the experimental groups and the controls, no differences can be found.

A majority of the respondents were male (56% versus 44% female), and a substantial proportion were younger than 35 years (58%), whereas only 3% were older than 55 years.

Most of the respondents have practiced downhill skiing before; only 8% were going to ski for the first time. More than half of the respondents were fairly experienced, having already skied during six seasons or more. However, having skiing experience does not mean that one is an advanced skier. A better means to indicate skill might be the level of difficulty of the ski runs. The more experienced the skiers, the more often they choose more difficult ski runs. Of the respondents in this study, 42% skied on easy ski runs, 54% on medium ski runs, and only 4% on difficult ski runs. Many of the surveyed skiers (70%) never ski on runs that are too difficult for them. More than a quarter (28%) do so now and then, while only 2% often does so. Skiers who go skiing more often are less inclined to ski on too difficult ski runs.

Respondents were asked about their physical preparation (ski gymnastics, fitness training) and their weekly number of hours of sports participation. One quarter of the respondents do not practice sports at all and did not prepare themselves physically for winter sports. Respondents were also asked to give an estimation of their own condition: 8% think their condition is bad, 60% think they are in reasonable to normal shape, and 33% think they are in good condition. No significant differences were found in physical preparation, number of hours of sports participation, and estimation of physical condition between skiers who adjusted their bindings and those who did not. The same holds for differences between the injured and the uninjured skiers in our study.

Approximately half of the respondents report to be aware of certain risks involved with skiing, and the more experienced the more aware one seems to be. As a rule, only those people who go on a ski vacation more often ski at higher altitudes. They are, in general, less afraid of accidents than people skiing at a lower altitude.

We found that three quarters of the respondents would check any advice on safety and health on its reliability and effectiveness before following such advice. Skiers showing a positive attitude toward observance of advice, indeed, did have their bindings adjusted more often. It is remarkable that more than half of the skiers have never been explicitly informed about how to prevent ski injuries. Almost 40% of the respondents had ever received such information from their ski instructor. On the other hand, some two thirds of the population said they had read, heard, or seen something, sometime about prevention of ski injuries by other media (newspaper, magazine, radio, television).

Injuries and Adjustment of Bindings

Almost 8% of the respondents had been injured during this (skiing) season (9.3 per 1000 skiing days); half of them were not seriously hurt, and their injuries did not withhold them

TABLE 2—*Kind and location of injuries (N = 89) (percentages).*

Kind		Location	
Bruise, strain, sprain	55.1	knee	29.2
Fracture	7.9	leg	15.7
Ruptured muscle	6.7	chest/shoulder	15.7
Dislocation	5.6	thumb	12.4
Ruptured ligament	3.4	neck/head	3.4
Cut	3.4	other	23.6
Unknown	18.0		

from skiing. About one third had to stop skiing for a couple of days. Table 2 shows the kind and location of the injuries. In more than 40% of the cases, the injuries were caused by a fall or a collision. Bindings are mentioned as a cause in only 7% of the cases. It is possible, however, that these figures are somewhat biased. For example, when a skier falls and the bindings do not release, the cause will probably be described as "fall" when, in fact, the injury was the result of unreleased bindings.

In our study, 83% of the population adjusted their bindings. A vast majority had them adjusted in a ski shop, and 35% of the whole population tested the settings of their bindings with a test device.

Differences Between the Groups

By analysis of variance (ANOVA), we examined the effect of the three conditions (medium, moment, approach) on changes in attention, comprehension, intention, and behavior.

An average of over 75% of the experimental groups remembers having received information materials. The cassette made the strongest impression. Of the respondents who received a cassette, 95% remembered it; only 55% of the respondents who received a leaflet remembered it. No differences in effect on remembrance are noticed between the varying periods of receiving the information before departure (one versus three weeks) nor between the varying approaches (high versus low degree of fear). Table 3 shows the differences among the experimental groups with respect to attention, operationalized as reading or listening to the message.

Only the "medium" condition appears to produce a main effect ($F(1, 784) = 5.5$; $p < 0.05$). Where the cassette has a higher score in remembrance, the leaflet scores higher in attention (measured in terms of reading and listening). A large part of the respondents (88%) kept the information materials. Almost two thirds of the respondents discussed the

TABLE 3—*Attention (mean scores) among respondents remembering having received information (N = 785).*[a]

Medium	Fear	Time	
		Short Period	Long Period
Cassette	high	2.62	2.68
	low	2.70	2.71
Leaflet	high	2.79	2.77
	low	2.78	2.79

[a]1 = Not read or listened to; 2 = partly read or listened to; 3 = read or listened to.

TABLE 4—*Comprehension (mean knowledge scores) among respondents in the experimental groups (N = 1040).*[a]

Medium	Fear	Time	
		Short Period	Long Period
Cassette	high	2.55	2.47
	low	1.90	2.42
Leaflet	high	2.51	2.21
	low	1.85	2.53

[a] −5 = all questions wrong; +5 = all questions correct.
Mean knowledge score in the control group ($N = 110$) was 1.70.

contents of the materials with other people. Those who received a cassette spoke with others (75%) about the content more often than those who received a leaflet (56%).

In summary, the cassette made a stronger impression on the respondents than the leaflet.

To measure the respondents' "comprehension" of the message, we asked a number of questions concerning the contents, added up on a knowledge scale (Cronbach's alpha = 0.56). After comparing the knowledge of the controls to the knowledge of all receivers of any information, a significant higher level of knowledge can be noticed in the experimental groups ($t(1019) = 2.34$; $p < 0.05$). The effects of the different conditions on the level of knowledge are presented in Table 4.

There is a significant interaction between moment of receiving and fear ($F(1, 1040) = 6.9$; $p < 0.05$). In other words, a combination of both conditions (high fear and long time) produces the maximum effect on the level of knowledge. The "medium" condition does not have a particular effect on knowledge.

There were no significant differences between the experimental groups and the controls in intention or behavior. Effects of the varying conditions on the intention to adjust the bindings are represented in Table 5.

With respect to intention, there appears to be a main effect of both time and fear ($F(1, 953) = 4.3$; $p < 0.05$; $F(1, 953) = 6.7$; $p < 0.01$). The information received shortly before departure produces the least effect on intention concerning adjustment of bindings. The same holds for information with a low degree of fear.

The effect of the different conditions on adjustment behavior is presented in Table 6. From this table we can conclude that the condition "fear" has a significant effect on the

TABLE 5—*Positive intention*[a] *(percentages) towards adjustment of bindings among respondents in the experimental groups*[b] *(N = 954).*

Medium	Fear	Time	
		Short Period	Long Period
Cassette	high	84	88
	low	76	87
Leaflet	high	94	88
	low	79	87

[a]Including those who actually adjusted their bindings.
[b]Percentage with positive intention in the control group ($N = 91$) was 82.

TABLE 6—*Adjustment behavior (mean scores) among respondents in the experimental groups (N = 940).*[a]

Medium	Fear	Time	
		Short Period	Long Period
Cassette	high	2.94	3.06
	low	2.76	2.97
Leaflet	high	3.05	3.08
	low	2.83	2.94

[a]1 = not adjusted, 2 = adjusted by themselves or by friends, 3 = adjusted in a ski shop, and 4 = adjusted in a ski shop and tested with a test device.

Mean score for adjustment behavior in the control group ($N = 89$) was 2.86.

adjustment behavior ($F(1, 939) = 5.6$; $p < 0.05$). A high degree of fear scores significantly higher than a low degree of fear, irrespective of time and medium. And these groups score significantly higher than the controls.

Discussion and Conclusions

This study served as a prototype for a national campaign to reduce ski injuries. However, it is difficult to prove that health education intervention can minimize the number of injuries. There are two reasons for this. First, one cannot expect that an occasional leaflet or cassette will have a permanent effect on the behavior of skiers. These mediums are primarily expected to increase the level of knowledge and to incite a process of consciousness. Second, considering the incidence of ski injuries, our study population is too small to detect a reduction in ski injuries. Furthermore, it is questionable whether the results of the study provide sufficient material for a mass media campaign. One characteristic of such a campaign is the undifferentiated target audience. In our study, we specifically asked for participation and we sent the information materials to specific addresses. This probably explains the high response to the study.

Basically, the problem consists of two related questions. The first is whether health education interventions can minimize ski injuries. Before the intervention we had to be certain that behavior is (partly) the cause of the problem. The available literature [2–5] convinced us that this is true. Furthermore, we assumed that it is very likely that intention and behavior concerning adjustment of ski bindings can be influenced and changed. We concluded that health education interventions can induce the desired changes.

The second question is which method is the most suitable to use in a campaign. This question is more difficult to answer. The present study shows that fear-arousing information materials produce the most effect. Such information emphasized mainly the seriousness of the injuries and the vulnerability of the skier. However, fear-arousing information materials are not recommended in every health problem. It can only be used adequately when the message gives precise directions, in terms of behavior, about how to prevent the health problem at issue. In the case of ski injuries, fear-arousing information turned out to be very suitable. Differences between leaflet and cassette are relatively small. The cassette makes a strong impression and has a clear after-effect because it stimulates listeners to discuss the contents with other people. But the high attention value of this medium can probably be explained by the fact that the cassette is rarely used to pass information. If it were used more often, this effect would probably be less evident. Where the main effects on knowledge, intention, and behavior are concerned, the leaflet gives about the same results as the cassette. For practical reasons, therefore, the leaflet is recommended.

Although we are convinced that the moment at which the message reaches the target population is essential in the information process, we could not prove this assumption empirically in this study. It seems very likely that the information materials sent shortly before departure on a ski vacation produce the least effect: the receivers probably do not have enough time to adjust the bindings adequately. It is therefore important to allow the target audience enough time to perform the desired behavior.

To produce effects on the level of knowledge, on intention, and on behavior, health education interventions have to be worked out methodically, systematically, and purposively. The message constitutes an essential part of the campaign. Messages of advice to prevent ski injuries have to be brief, comprehensible, and easy to carry out. Before implementation of an intervention, it has to be established beyond reasonable doubt that the advice actually leads to the desired change of behavior.

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