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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

[Link to publication in VU Research Portal](#)

citation for published version (APA)

Bouter, L. M., & Kok, G. J. (1991). Planning health education for downhill skiers. In *Skiing trauma and safety: 8th International Symposium* (pp. 249-256). ASTM.

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Planning Health Education for Downhill Skiers

REFERENCE: Bouter, L. M. and Kok, G. J., "Planning Health Education for Downhill Skiers," *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. 249–256.

ABSTRACT: The planning of health education to prevent ski injuries is often incomplete and not stated explicitly, while the evaluation of health education is executed only partially or not at all. This article presents a theoretical framework for planning and evaluating health education for downhill skiers. Systematic planning consists of an analysis of the magnitude of the problem, an analysis of the behavioral risk factors, a study of the determinants of the behavior at issue, the design of an optimal intervention, and the implementation of this intervention. The evaluation phase deals with the effects of the planning on these five levels (implementation, intervention, determinants, behavior, and injury risk). Some common pitfalls are mentioned, and special attention is given to the study of determinants of behavior and to the design of the intervention. Furthermore, the importance of pretesting health education material is underlined. There seems to be a strong need for further research on the etiology of ski injury and its determinants of behavior before prevention can be realized.

KEY WORDS: downhill skiing, injury, health education, determinants of behavior, pretesting, evaluation

While most people agree that participation in recreational downhill skiing is conducive to health, the negative consequences in the form of injuries generally attract less attention. Available data on the incidence of ski injuries indicate that the problem is a substantial one in terms of morbidity, medical consumption, and absence from work and sport [1]. Health education is often advocated as a solution and a means of prevention. The planning of these health education activities is often incomplete and not stated explicitly. Furthermore, the evaluation usually is executed only partially or is altogether nonexistent, although at least some work is done in this field [2].

This article presents a theoretical framework for planning and evaluating health education for downhill skiers. The specific examples given from the ski injury literature are only to provide an illustration of the theoretical considerations. Most of them are simplistic generalizations and could be criticized easily. For a more realistic overview of the etiology of ski injuries in general, and of behavioral risk factors in particular, the reader is referred to other publications [3,4].

The central thesis of this paper is that the effectiveness of health education for downhill skiers is determined by the quality of the planning process [5,6]. A thorough evaluation of the health education intervention is a condition *sine qua non* for establishing this effective-

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ness. Therefore, this paper presents an overview of the several phases of the process of planning and evaluating health education aimed at the prevention of ski injuries. Several common pitfalls are also mentioned. Special attention is given to the study of the determinants of behavior and to the design of the behavioral intervention. Finally, a number of conclusions are drawn, and some priorities for future research are mentioned.

Planning Health Education

A model for explicit planning and evaluation of health education is presented in Fig. 1. Planning and evaluation each have five related steps. These ten steps in total can be indicated by their central questions. These questions are presented below, and as an example, the prevention of ski injuries as a result of inadequate binding adjustment will be taken.

Step 1: How Serious Is the Problem?

Most authors agree on an incidence of 2 to 4 medically treated ski injuries per 1000 ski person days [1,3]. About 50% of these are lower extremity equipment-related (LEER) injuries [7]. This certainly does not mean that this subgroup of injuries can be fully attributed to the failure of the ski bindings to release in time. There are reasons to believe that only lower leg injuries (about 12% of all injuries [8]) are likely to be amenable to prevention by current binding systems.

Step 2: What Behavior is Involved?

In the literature, an abundance of putative behavioral risk factors for ski injury are mentioned [1,3]. However, studies adequately establishing and quantifying the etiological role of these factors are very sparse. While clearly not all LEER injuries can be prevented by an optimal adjustment of the current ski bindings, it still appears to be possible to lower injury rates further by promoting proper binding adjustment procedures [9]. A recent German preventive trial shows (again) that bindings generally are adjusted far above the recommended setting and that readjustment by an expert may even lower the incidence of LEER injuries by a factor of three [10], although this large effect could be doubted on biomechanical grounds and might be specific to the particular population of skiers included in this study.

FIG. 1—Model of planning and evaluating health education.

Step 3: What Are the Determinants of the Behavior?

A limited study of the behavior determinants [11] indicated that one of the most frequently observed mistakes is that skiers adjust their binding much too high after a fall that the skier interpreted to be due to inadvertent release. In this study, the belief that adequate adjustment can prevent injury and can also prevent inadvertent release appeared to be an important determinant of the desirable behavior. Furthermore, it turned out that skiers are more likely to have their bindings adjusted if they think that experts favor taking this action [11]. Of course, determinants of other identified behavioral risk factors should be studied as well.

Step 4: What Options Are There for Change?

Health education intervention could stress the opinion of experts on the subject of the health education and, for example, make clear what the relation is between suboptimal binding adjustment and injury risk. Special attention might be given to explaining that adequately adjusted bindings almost never release inadvertently. These are several ways to formulate this message. A recent study [12] revealed that phrasing the information in a mildly fear-arousing way was more effective for this purpose than a more neutral formulation.

Step 5: How Can That Be Implemented?

Next the channel and the moment of the health education intervention have to be decided on. In the Dutch study mentioned above [12], postal delivery of an audio cassette about one week before the beginning of the winter sports holiday appeared to be relatively effective compared to brochures and to earlier delivery.

Step 6: Has the Implementation Been Carried Out as Planned?

This step is designed to ensure that the defined population of skiers at risk for injury actually received the health education intervention. This is a necessary, although not a sufficient, condition for effectiveness.

Step 7: Has the Intervention Been Released as Planned?

This step determines whether the skiers understood the message contained in the health education intervention. Failure to make fully clear which preventive behavior (for example, adjustment by an expert) is expected to reduce risk can be another source of ineffective prevention of ski injury.

Step 8: Have the Determinants of the Behavior Changed?

This phase is concerned with establishing whether the prevalence of the determinants of the desired behavior has risen satisfactorily. In our example, this part of the evaluation should focus primarily on the perceived advantages of adequate adjustment and the perception of the opinion of experts.

Step 9: Has the Behavior Changed?

Health education aims at modifying behavior. Therefore, quantifying behavioral change is important in the evaluation process. For the skiers from our example, this entails the question whether the target population engages in optimal binding adjustment more often.

Step 10: Has the Problem Been Lessened?

Of course, this is the ultimate measure of efficacy; Steps 6 to 9 can be considered the intermediary steps. In the example, the postintervention incidence of injury, more specifically of LEER injury, indicates the overall effectiveness of the health education intervention. For methodological reasons, this straightforward measure is often not presented. Unfortunately, it can be calculated that even a 50% decrease in incidence from 4 to 2 injuries per 1000 ski person days fails to reach statistical significance (at $\alpha = 0.05$) in a study involving 500 skiers, each skiing 10 days, half of them receiving the intervention and the other half being the control group [13].

Pitfalls

Unfortunately, the ten steps mentioned above are often not given the appropriate attention. The most common mistake is that people jump from the problem to the intervention without answering the planning questions in between. Furthermore, because evaluation is rare, the ineffectiveness of such interventions remains hidden. Evaluation is necessary for testing previous decisions and for making corrections to improve the intervention. Careful planning can avoid a number of potential pitfalls that we will describe and illustrate with examples.

Pitfall 1

Development of an intervention for a problem that does not exist. In our example, ski injuries are clearly a substantial problem, especially when analyzed in terms of incidence figures and severity of the injuries. However, it can be argued that the focus on LEER injuries is not justified because the proportion of them that would be preventable by optimally adjusting bindings might be much smaller than suggested by some authors [4,10].

Pitfall 2

Development of an intervention addressing behavior lacking a clear relationship with the problem. An example would be a program aimed at reducing levels of alcohol consumption during skiing. In contradiction to population opinions on this subject, empirical data show that detectable levels of alcohol in blood and breath among injured as well as among uninjured skiers have a prevalence of only a few percent [1,14]. So clearly there would be no need for an intervention because the behavior is not related to the problem. As another example, Bouter [1] showed that participation in ski gymnastics has probably no relation to the risk of having an injury. So an intervention advising skiers to participate in ski gymnastics can be *successful* if it has a high participation rate, but it may not be *effective* because no injuries are prevented. This possible pitfall is, in our opinion, currently the predominant threat to effective prevention of sports injuries. Valid knowledge about most putative behavioral risk factors contributing to the etiology of ski injury is still lacking [1,3,4].

Pitfall 3

Development of an intervention that is based on a misconceived idea about behavior determinants. An example is the educational programs on warming up for downhill skiers, based on the idea that people do not know how to perform the warming up exercises. The majority of people may know very well how to warm up but they do not want to do it,

because, for instance, they think it ineffective or ridiculous. A general finding in health education research is that when a relation is shown between a health problem and behavior, knowledge about that relation is enough for some people to change their behavior. For a substantial group, however, knowledge is not enough. We elaborate on this point later when we describe models of behavior determinants.

Pitfall 4

Development of a wrong intervention, for instance, an intervention aimed at the wrong group. An example of this would be school health education with the message that children ought to wear close-fitting ski boots not made of thermoplastic material [1,14]. This could be ineffective because usually parents make the final decisions in buying ski equipment.

Pitfall 5

Development of a potentially effective intervention with a wrong implementation. For example, facilities for adequate and nonprofit binding adjustment may be made available to the subscribers to a ski magazine. The information about this service would probably not reach the majority of beginner skiers who may not subscribe to a ski magazine, who are generally more accident prone, and who often have badly adjusted bindings [1,3,4].

Pitfall 6

Unjustified satisfaction about the intervention. This concerns the failure to evaluate the intervention thoroughly. For instance, it could take the form of satisfaction about the large number of brochures on injury prevention handed out to skiers waiting for the ski lifts, with no notice taken of whether the number of injuries has been reduced.

Determinants of Behavior

In general, health educators have to rely on the epidemiological literature identifying the magnitude of the problem and the behavior that is (causally) involved (Steps 1 and 2 in Fig. 1) [13]. When such behavior is identified, the next step for the health educator consists of the clarification of its determinants. Figure 2 presents a recently developed model of behavior determinants [15]. This model states that external variables can influence behavior along three different pathways.

1. An *attitude* is the weighing of all the advantages and disadvantages of performance of the behavior, as seen by the individual. Health is only one of the possible considerations and often an unimportant one. When health is a part of the attitude, we may suppose that health motivation is a combination of the perceived severity of the health risk, the perceived

FIG. 2—Model of behavior determinants adapted from DeVries et al. [15].

susceptibility to the health risk, and the effectiveness of the preventive behavior. But, again, health considerations are mostly not dominant and other considerations like costs, (dis)like, status, and so forth, are often more important. For downhill skiers, risky behavior may even have a pleasant, stimulating effect. Skiers appear to have a relatively high sensation-seeking score, although predicted differences between injured and uninjured skiers could not be confirmed [16]. As said before, knowledge about risks is, for most people, not enough. A painful example is the unhealthy lifestyle of many physicians.

2. *Social influence* is the influence of others: directly by what others expect or indirectly by what others do (modeling). Social influence is often underestimated as a determinant of behavior. Social psychological studies show that social influence can lead to behavior that conflicts with previous attitudes, and most sport situations are social situations. The basis for social influence lies in two principles: people like to have the right information and the ideas of other people are sources of information, and people like to be socially rewarded, like getting compliments from others and belonging to a group. An example of the latter would be the often described situation of beginners taking much too difficult ski runs as a result of persuasion by more advanced members of the same ski party [14].

3. *Efficacy cum barriers* determines whether one is able to perform the (desirable) behavior. Efficacy is a person's estimation of his or her ability to perform the behavior; barriers are the real problems inside or outside the person that they face in actually behaving (inside: insufficient knowledge, skill, or endurance, and so forth; outside: resistance from others, time and money not available, conflicting lifestyle, and so forth). There is a logical relation between (perceived) efficacy and (real) barriers, but there is also an important relation between efficacy and success in performing the behavior. People with a higher efficacy have a higher chance of succeeding, independent of the existing barriers. But the discrepancy between (perceived) efficacy and (real) barriers should not become too large. Health educators can try to increase the efficacy to motivate people to adopt the preventive behavior. At the same time, however, they should help people to overcome barriers to performing that behavior. An example of a barrier to adequate adjustment of ski bindings is the limited availability of ski shops equipped with the appropriate test device [9]. Perceived inefficacy among beginning skiers often seems to focus on their inability to control velocity while descending a slope. Taking ski lessons might increase perceived efficacy [1,4].

We have described in theory the three determinants of behavior. To our knowledge, there are no systematic empirical studies on the determinants of desired and undesired behavior with respect to most putative behavioral risk factors for ski injuries. This is clearly an omission in research, and the gap needs filling urgently. Assuming that in the near future this kind of research will be conducted and specific determinants of behavior will be known, how do we get from determinants to interventions?

Behavioral Intervention

Changing by health education means changing by communication. Therefore, the first goal is to get attention and comprehension. Having achieved this and, subsequently, a change in determinants, the third and last goal is the maintenance of the behavior change. A once-only change is not enough; we want the desired behavior to become a habit. The major problem in achieving maintenance of behavior change is the possible negative experiences people have when performing the desired behavior. Health educators should always be realistic about the experiences after the change to the desired behavior. Mostly these experiences are not very positive in the short run.

Sometimes it is possible to present “organized” positive experiences, for instance, by presenting data about the number of ski injuries prevented related to the year before. In our example, this would mean informing downhill skiers of the number of LEER injuries prevented by the optimal binding adjustment. The best moment for this communication would seem to be shortly before the next winter sports season.

Figure 3 shows the three health education goals combined with four communication variables in the so-called health education matrix adapted from that devised by McGuire [17]. The cells of this matrix indicate decisions that have to be made, for example, which source attracts the most attention, which channel is able to change social norms, which group of receivers should be specially prepared for negative experiences, and so forth. In the literature [17], a rich quantity of empirical data can be found with respect to every possible decision.

Educational materials must be pretested to check whether they have the intended effect on the receivers, especially with respect to attention and comprehension [18]. It is not enough that all kinds of specialists on ski injuries agree that the information in the materials is correct. The next step is to have communication specialists judge the materials, and a final step is to try out the materials on a sample of the target group [18]. Only then is it possible to prevent all kinds of possible unwanted side effects that have not been recognized by the health educators themselves.

Pretesting should be integrated in the materials development process. To our knowledge, only one study deals with pretesting health education material for downhill skiers [12]. In this example, pretesting indeed led to major changes in the material.

Conclusion

Until now, prevention of ski injuries have been dominated by medical and technical experts. To be effective, these efforts should be supplemented by health education specialists. This cooperation may achieve a further reduction of ski injuries within the next 10 to 20 years. Health education can be an effective way of preventing ski injuries, but the effectiveness of health education depends on the quality of the planning. That means a careful analysis of the problem, the behavior, the determinants, the intervention, the implemen-

	Source	Message	Channel	Receiver
Attention & comprehension				
Change in attitudes, social influence, efficacy cum barriers				
Maintenance of behavior change				

FIG. 3—Health education matrix adapted from McGuire [17].

tation, and of the strength of the relationship between these five aspects. It is our opinion that, with respect to the prevention of ski injuries, we have not yet reached the stage that we know what to advise people. Epidemiological studies on the etiology followed by research on the determinants of the behavior at issue are necessary to fill in the gaps in our knowledge.

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