Wilderness and Environmental Medicine, **20,** 269–274 (2009)

ORIGINAL RESEARCH

Risk Assessment in Winter Backcountry Travel

Natalie A. Silverton, MD; Scott E. McIntosh, MD; Han S. Kim, PhD, MSPH

From the Division of Emergency Medicine, University of Utah, Salt Lake City, UT (Drs Silverton, McIntosh, and Kim).

Objective.—Risk assessment is an important part of safe backcountry travel in avalanche terrain. The purpose of this study was to determine and compare the ability of backcountry travelers to accurately estimate the avalanche danger for their destination and time of travel.

Methods.—We surveyed 353 winter backcountry users, asking them to rate the avalanche danger for their destination that day. We then compared this estimation to the Utah Avalanche Center daily advisory for that specific location, aspect, and elevation. Tendency to underestimate the avalanche danger was then compared across 6 different sports (backcountry skiing, backcountry snowboarding, snowshoeing, snowmobiling, out-of-bounds skiing, and out-of-bounds snowboarding) as well as across age, gender, and subject participation in an avalanche safety course.

Results.—A comparison across different sports, adjusted for age and gender, showed that snowshoers were 7.11 times more likely than skiers to underestimate the avalanche danger (95% CI, 2.95, 17.11). This difference was maintained after adjusting for past education in an avalanche safety course (odds ratio, 5.74; 95% CI, 2.28, 14.46). Snowmobilers were also significantly more likely to underestimate the avalanche danger when compared to skiers (odds ratio, 3.11; 95% CI, 1.12, 8.24), but these differences ceased to be significant when the data were adjusted for avalanche safety course (odds ratio, 2.39; 95% CI, 0.84, 6.74). While there was a trend for women and older age groups to underestimate the avalanche danger when compared to men, these trends were not significant.

Conclusions.—Snowshoers and snowmobilers are groups that tend to underestimate avalanche danger when traveling in the backcountry. These groups may be unknowingly assuming a higher risk and should be targeted for avalanche education and awareness.

Key words: avalanche, risk assessment, safety, education, skiing, snowboarding, snowmobiling, snowshoeing

Introduction

Unlike a ski resort, the winter backcountry is not patrolled for hazards. Venturing into the backcountry can therefore involve a great deal of risk. In recent years, the number of avalanche fatalities in the United States has increased.[1] Efforts have been made to educate the public about the potential hazard that avalanches pose. This has been accomplished through avalanche education courses or through daily avalanche advisories. Although organizations can educate the public and provide advisories, it is ultimately up to the individual to make sound decisions. Safety in the backcountry depends in part on one's ability to correctly assess the avalanche danger. Travelers must decide whether it is safe to enter the backcountry on a particular day, where to travel, and what safety precautions and equipment to utilize. These risk assessment decisions are entirely within the control of the backcountry user.

We evaluated the risk assessment skills of backcountry travelers engaging in a variety of winter sports in the Wasatch and Uinta mountains of Utah between November 2005 and March 2006. By doing so, we hoped to identify groups of backcountry travelers that could be targeted for avalanche education.

Methods

A convenience sample of backcountry users traveling in the Wasatch and Uinta mountains was surveyed during the 2005–06 winter season. Inclusion criteria were defined as those entering the backcountry whose destination involved travel into an area with potential

Corresponding author: Natalie A. Silverton, MD, University of Utah, Division of Emergency Medicine, 30 North Medical Dr, Salt Lake City, UT 84132 (e-mail: natalie.silverton@hsc.utah.ed).

avalanche hazard. Potential avalanche hazard was defined as traveling on any slope greater than 25° or crossing a major slide path. Users included backcountry skiers, snowboarders, snowshoers, snowmobilers, out-of-bounds skiers, and out-of-bounds snowboarders.

'Out-of-bounds' users were defined as those leaving the ski resorts in order to travel in areas that were not controlled for avalanches. We assumed that accessing the backcountry from the ski resort requires less planning, forethought, and preparation than a traditional backcountry tour because of the ease of lift access. It is for this reason that we chose to distinguish between 'out-of-bounds' resort skiers/snowboarders and traditional backcountry travelers. Participants were recruited at 12 different trailheads along the Wasatch Front and on a number of ski, snowshoe, and snowmobile trails in the Wasatch and Uinta mountains. Out-of-bounds skiers and snowboarders were recruited for the study at the out-of-bounds exit gates at 2 ski resorts, Brighton and The Canyons. These resorts were selected because access to the backcountry from these areas is easy, unlimited, and very popular. Both ski resorts do make efforts to inform the public about avalanche danger with graphic warning signs at the access gates.

Data were collected using a written questionnaire. Information collected included demographics, mode of travel, and the location of the participant's destination. Participants were then asked to assess the avalanche danger that they expected for that destination. The aspect and elevation of the participant's destination were researched by the authors. Avalanche forecasts for each day of data collection were obtained from the Utah Avalanche Center (UAC) daily advisory for that morning and compared to the participant's estimation of the avalanche danger for the specific aspect and elevation of their destination. The UAC provides daily avalanche condition forecasts for the Wasatch and Uinta mountain ranges during the winter season. These forecasts are compiled by professional avalanche forecasters who monitor the snow conditions on a daily basis. The UAC uses a standard ranking system for avalanche danger, as follows: low, moderate, considerable, high, or extreme. Definitions for these terms can be found on the UAC website (www.avalanche.org/~uac/). For example, on a given day, south-facing slopes may be reported as presenting low danger, while north-facing slopes could be reported as presenting considerable danger. In that case, if a skier's destination was a north-facing slope, his/her own assessment of the danger level was compared to the UAC forecast of considerable danger. The difference between perceived danger and that reported in the UAC advisory was then used to assess the participant's ability to correctly assess the avalanche danger.

Participants were also asked if they had taken an educational avalanche safety course and if they had accessed the UAC daily advisory that morning. They were also asked to identify the type of avalanche safety equipment they were carrying. The latter information was presented in a separate paper entitled ''Avalanche Safety Practices in Utah,'' in which we compared the use of avalanche safety equipment among the different groups of backcountry travelers.[2] The survey took 3 to 5 minutes to complete. The study team recorded the date, time, location, weather conditions, whether the participant was traveling to or from his destination, and the type of equipment used (skis, snowshoes, etc). (The entire survey and the additional participant information recorded by the study team can be viewed online at http://www.wemjournal.org.) Participants were screened so that they only completed the survey once. We made efforts to collect data in all weather conditions and at various levels of avalanche hazard.

Participants who overestimated the avalanche danger (reported that the danger was high, for example, when the UAC report said it was low) were grouped with those who correctly estimated the danger. Overestimating danger would encourage the backcountry traveler to avoid terrain and therefore decrease the risk of an avalanche accident. In contrast, underestimating the danger (stating that the danger was lower than what was reported) could actually increase the risk of traveling in avalanche terrain and the risk of being caught in an avalanche. Participants' evaluation of the avalanche danger was then compared across age, sex, and sport using a logistical regression statistical technique. We chose backcountry skiers as a comparison group, because traditionally many of the pioneers of avalanche safety and many of the proponents of avalanche education have been backcountry skiers. Also, in our prior study we found that backcountry skiers were more prepared than other groups of backcountry travelers, as they tended more often to travel with an avalanche transceiver, a shovel, and a partner.[2] Logistic regression was also used to adjust for a prior history of an avalanche safety course, because this could influence the participant's ability to assess the avalanche danger. Odds ratios and 95% CIs for underestimating the avalanche danger were then compared. All statistical tests were 2-sided with a significance level of $\alpha = .05$.

The study was reviewed and approved by the University of Utah Institutional Review Board. SAS 9.1.2 (SAS Institute, Cary, NC) was used to analyze data.

Results

Three hundred and eighty-eight backcountry travelers were approached to participate in the survey. Of these, 35