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In Response to Risk of Avalanche Involvement in Winter Backcountry Recreation: The Advantage of Small Groups by Zweifel et al

To the Editor:

Zweifel et al¹ investigate the relationship between avalanche risk and group size. They find that groups of 4 or more have a higher relative risk of an avalanche accident than individuals or groups of 2. Multiple websites popular among backcountry skiers have interpreted this finding as evidence that solo backcountry skiing might be safer than being in a group.^{2–4} These commentators seem to have overlooked that Zweifel et al focus on the relative risk of a group being involved in an accident. This is not the same as the relative risk of an individual in a group being involved in an accident. In fact, the empirical findings of Zweifel et al indicate that the risk of an individual being the victim of an avalanche accident is approximately independent of group size.

Suppose that the probability that an individual is involved in an avalanche is independent of group size. If we say that a group was involved in an avalanche if 1 or more individuals in the group were involved, then we would expect the probability that a group has an accident to be roughly proportional to group size. To be exact, if the probability of an individual accident is p , then the probability that a group of size n has an accident is $1 - (1 - p)^n \approx np$. The relative risk of a group of size n compared with a group of size 2 is $1(1p)^n / (1p)^2 \approx 2n$. The relative risk estimates of Zweifel et al

very closely follow this pattern. For almost all group sizes and data sources, the 95% confidence interval for relative risk contains the relative group risk that one would expect if individual accident risk were independent of group size (the 2 exceptions are Davos self-registration with a group of size 4 and Tyrol with a group of 1).

Given that this article has been of interest to many backcountry skiers, it is important to communicate the results in manner that is easy for anyone to understand and incorporate into their decision making. I would emphasize the following: The results suggest that the probability that an individual gets in an accident is approximately independent of group size. The probability that someone else in a group is involved in an accident increases with group size, but not any more than would be expected from adding independent events. It is approximately equally likely that a person among 3 groups of 2 will have an accident as it is that a person in 1 group of 6 will. This is somewhat counterintuitive in that the 3 groups of 2 are likely to choose different routes, and so would be exposed to more potential avalanche terrain than a group of 6 that travels together. In this sense, there is some evidence in favor of the conventional wisdom that larger groups make poorer decisions. On the other hand, individual accident risk appears to be about the same regardless of group size, and a larger group would likely be more effective for companion rescue.

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In Reply to Dr Schrimpf

To the Editor:

As noted by Dr. Schrimpf in his response¹ to our article,² our investigation of group size and avalanche risk did not adequately differentiate *group* risk from *individual* risk. We appreciate Dr. Schrimpf's input and support his remarks in this context. In our study, we found that the risk of an avalanche accident increases with group size (based on an analysis of accidents with at least 1 backcountry recreationist caught in the avalanche). However, we did not report the number of people per group who were caught or killed in these accidents and thus did not report individual risk. It is plausible that survival chances are higher for recreationists in large groups compared with small groups due to more resources for companion rescue.

Based on our dataset from the Swiss avalanche database (winter 2003–2004 to winter 2012–2013, 446 accidents), an individual's chance of survival increases with increasing group size: 76% for individuals travelling alone, 88% for those in groups of 2, 92% for those in groups of 3, 96% for those in groups of 4, 100% for those in groups of 5 (there were no fatalities in 5-person groups), and 97% for those in groups of 6 or more. If we combine these numbers with the findings from our study² and Dr. Schrimpf's comment,¹ we conclude that a group's risk of being involved in an avalanche accident is higher for larger groups than for smaller groups and increases approximately according to group size, while survival chances also increase with group size. Hence, the risk of an individual being involved, or dying, in an avalanche accident is independent of group size.

This has two main implications:

1. Larger groups cause relatively more accidents than smaller groups. According to Harvey et al.,³ we mentioned 5 different causes of increasing risk in large groups that are either related to snowpack properties or to communication and aspects of decision-making. Large groups should adopt strategies to reduce load on the snow cover (eg, spacing between single skiers or skiing steep slopes 1 by 1). They

should also be aware that they are particularly prone to group decision pitfalls and use strategies to reduce this risk, such as the group check tool SOCIAL.⁴

2. Backcountry users travelling by themselves or in small groups should be aware of lower survival chances (statistically) compared with larger groups and make decisions accordingly.

Finally, recreationists should not forget that severe avalanche accidents not only affect the individual(s) involved in an avalanche, but also the physical and mental health of fellow group members.

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