

ADHERENCE TO RISK PREVENTION AND SAFETY MEASURES IN BACKCOUNTRY WINTER RECREATIONISTS

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ABSTRACT: Rapid extrication within 10-20 minutes of complete avalanche burial is essential for survival (Haegeli et al. 2011). Safety equipment, along with basic risk prevention measures, is known to decrease the mortality of avalanche burial (Brugger et al. 2007). An accurate estimation of the number of recreationists within a precise geographic region and timeframe is lacking due to feasibility issues of in-field surveys. The aim was to perform a comprehensive survey of backcountry skiers and snowshoers to characterize adherence behaviors in these activity groups. The survey was completed over a 1-week period in February 2011 in South Tyrol, Italy. In total 5576 individuals (77.7% skiers, 22.3% snowshoers) were surveyed. 75.6% of individuals reported having read the avalanche bulletin for the given day, although only 53.4% were able to indicate the correct avalanche danger rating. 80.6% of skiers and 13.7% of snowshoers ($p < 0.001$) were in possession of standard rescue equipment (transceiver, probe and shovel). The percentage of individuals reporting both correct danger rating and standard equipment was lower (skiers 51.0%, snowshoers 8.3%; $p < 0.001$). Other survival devices were less frequent (Airbag 3.6%; AvaLung 0.4%). These results highlight a surprisingly low adherence to basic safety measures in a region with a high level of avalanche awareness and a highly organized mountain rescue service. This indicates the need to assess the effectiveness of information-transfer and to tailor educational campaigns to specific recreation groups. A trans-national survey over a complete winter season is needed to allow a reliable calculation of morbidity and mortality in these sports.

1. INTRODUCTION

Risk reduction during winter recreation in avalanche terrain can be achieved by adherence to established prevention and safety measures. While the purpose of prevention measures are to avoid involvement in an avalanche, safety measures become important after involvement and include, for example, companion rescue equipment and floatation devices. Nevertheless, survival after involvement in an avalanche burial remains low; overall survival probability for victims of complete burial is 46.8%, with the most determinant factor being duration of burial (Haegeli et al. 2011).

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Location of a victim with an avalanche transceiver is associated with significantly lower duration of burial and a 74% reduction in relative risk of mortality in completely buried victims (Brugger et al. 2007; Hohlrieder et al. 2005). Similarly, the relative risk of mortality is reduced by 91% in victims equipped with an avalanche Airbag (Brugger et al. 2007).

While it may be that the wide-reaching initiatives in avalanche education and the continuing optimization of safety equipment have positively influenced winter recreation (Etter et al. 2008), only few studies have collected actual participation rates or avalanche prevention and safety practices in winter recreationists (Zweifel et al. 2006; Silverton et al. 2007, 2009). Therefore the aim of this study was to collect the first comprehensive survey of backcountry skiers and snowshoers in a region in the European Alps to characterize adherence behaviors in these activity groups.

2. METHODS

This study included a convenience sample of backcountry skiers and snowshoers at 22 identified points (parking lot, trail head, etc.) over a 1-week period in February 2011 in South Tyrol, Italy (Figure 1). The selection of sampling points was based on the results of a 1-day pilot survey at 143 points in South Tyrol in 2010 (Brugger et al. 2010). All skiers and snowshoers departing for a tour between 7 a.m. and 1 p.m. were included. Out-of-bounds or off-piste recreationists (i.e. ascent with aid of ski lifts) were not surveyed.

Demographic parameters of individuals (age, gender, nationality and average number of tours per season) and groups (group size, tour start time) were collected. Prevention measures included knowledge of the local avalanche bulletin and indication of the corresponding danger rating. Safety measures included presence of standard rescue equipment (transceiver, probe and shovel) and other devices (Airbag, AvaLung). Chi-squared (X^2) test with Phi coefficient (Φ) is reported for comparisons between groups and $p < 0.05$ was considered significant.

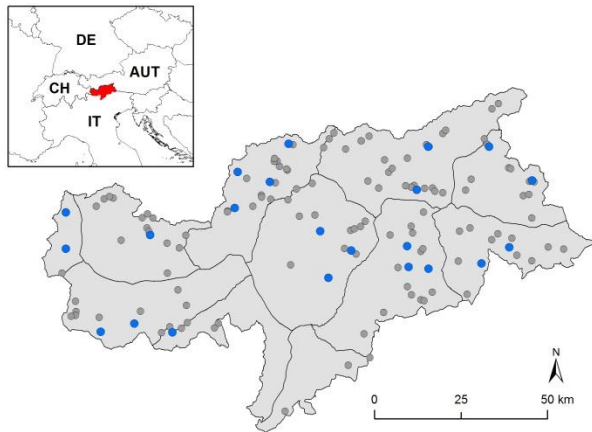


Figure 1: Geographic distribution of survey points in 2010 (grey) and 2011 (blue), South Tyrol, Italy, which has an area of 7400 km² and a population of 511,750.

3. RESULTS

3.1. Individual and group demographics

In total 5576 individuals (77.7% skiers, 22.3% snowshoers) in 1927 groups were counted (Table 1). 68.8% of the sample was counted on the weekend. A higher proportion of the skiers (80.3%) reported having done >10 tours in the winter season compared to snowshoers (42.7%; $X^2=667$, $\Phi=0.35$; $p < 0.001$). The most frequent

group size was 3–5 people; large groups (≥ 10 people) were more common amongst snowshoers and 73.4% of single-person groups were individuals from South Tyrol. In total 47.4% of individuals were from the region of South Tyrol, 32.8% from Austria, Germany or Switzerland, and 19.1% from other regions of Italy.

Table 1: Demographic parameters by sport type.

	Skiers		Snowshoers	
	n	%	n	%
Participants (n)	4333	77.7	1243	22.3
Gender				
Male	2961	69.6	633	52.1
Female	1293	30.4	581	47.9
Total	4254	100.0	1214	100.0
Age (years)				
≤ 18	35	0.8	50	4.1
19–39	1482	34.6	277	22.7
40–59	2361	55.0	661	54.2
≥ 60	411	9.6	232	19.0
Total	4289	100.0	1220	100.0
Tours (n)				
≤ 10	849	19.7	692	57.3
11–30	1955	45.2	398	33.0
>30	1518	35.1	117	9.7
Total	4322	100.0	1207	100.0
Group size (n)				
1	363	8.4	58	4.7
2	1266	29.2	346	27.8
3–5	1634	37.7	363	29.2
6–9	669	15.4	151	12.2
≥ 10	401	9.3	325	26.1
Total	4333	100.0	1243	100.0

3.2. Prevention and safety measures

In total 75.6% of individuals reported having read the avalanche bulletin for the given day, although only 53.4% were able to indicate the correct avalanche danger rating, and this was lower for snowshoers (37.4%) compared to skiers (58.0%; $X^2=142$, $\Phi=0.17$; $p < 0.001$). Incorrect reporting of the danger level was most frequent in visitors from other regions. The highest percentages of individuals who had not referred to the avalanche bulletin before their tour were those in late-starter groups, single-person groups and those reporting fewer tours in the season (data not shown).

Avalanche transceivers were carried by 89.0% of skiers and 24.1% of snowshoers, but complete standard rescue equipment was even less common (skiers 80.6%; snowshoers 13.7%; $X^2=1920$, $\Phi=0.59$; $p < 0.001$) as were other safety

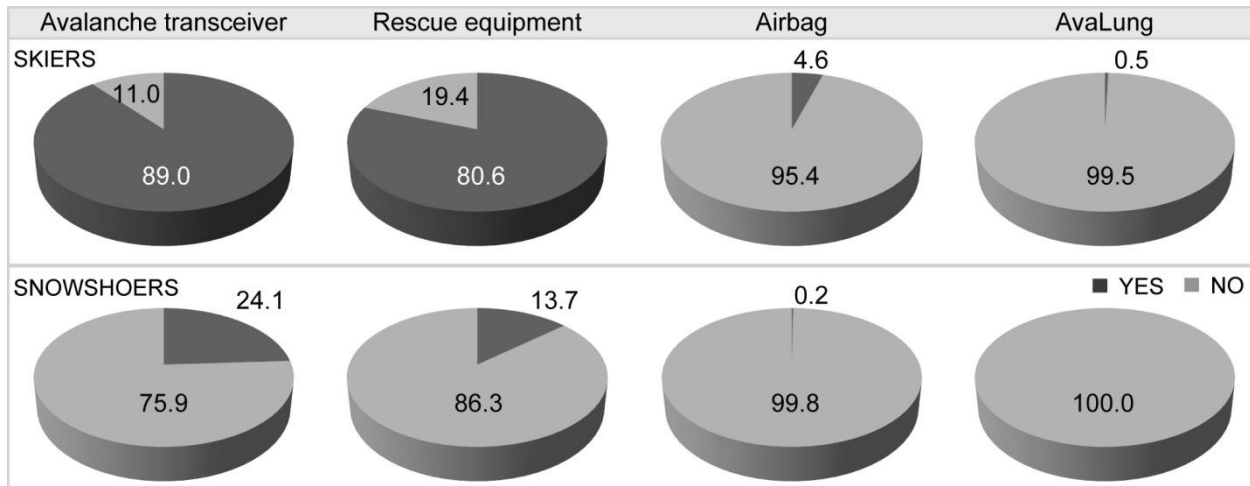


Figure 2: Prevalence of safety devices. *Rescue equipment* denotes a complete set of transceiver, probe and shovel.

devices (Figure 2). The combination of reporting the correct danger rating and carrying complete rescue equipment was more frequent for skiers (51.0%) compared to snowshoers (8.3%; $X^2=625$, $\Phi=0.36$; $p<0.001$). The lowest adherence to both measures was demonstrated by the late-starter groups, smaller groups and those reporting fewer tours in a season (data not shown).

4. DISCUSSION

This survey of backcountry skiers and snowshoers provided a characterization of adherence behaviors in these activity groups for a sample in South Tyrol and highlighted the high proportion of snowshoers in this region.

The large discrepancies between skiers and snowshoers both in prevention and safety measures are coherent with previous findings of Silverton et al. (2007, 2009) who reported lower level of preparedness and higher likelihood of underestimating danger levels in snowshoers compared to other backcountry recreationists in a sample in Utah, USA. Similarly, 98% of skiers but only 16% of snowshoers were equipped with avalanche transceivers in their sample. Carrying standard rescue equipment by all group members and training in correct usage is paramount for efficient companion rescue and improving survival probability of avalanche victims (Hohlrieder et al. 2005). Thus the low percentage of snowshoers with rescue equipment in our study is noteworthy. However, a more detailed analysis would be required to fully characterize the exact subsample without standard rescue equipment and the corresponding tour characteristics, e.g. terrain difficulty, avalanche danger level.

South Tyrol is a region with a high level of media exposure around avalanche awareness. Although no information was collected on previous avalanche education or training of participants, it could be assumed that low adherence is more a matter of negligence than lack of knowledge in many cases. On the other hand, the highly organized mountain rescue services in this region and the possibility for rapid transport to advanced medical care likely influences risk perception of some recreationists, but drawing conclusions on this was not the aim of the study. However, these regional characteristics may partially distinguish winter recreation here from that in larger or more remote regions, such as North America.

The demographic groups that emerged as the least adherent were clearly those with less experience in a winter season, late-starter groups and small groups (≤ 2 persons). Further information would be required to explain the low adherence to prevention measures of individuals alone on a tour. The high percentage of incorrect answers for the danger level from visitors from neighboring regions suggests the need to increase cross-border broadcasting of avalanche bulletins and assess deficiencies in users' application of this information.

5. CONCLUSION

These results indicate the need to assess the effectiveness of information-transfer networks and to continue to tailor educational campaigns to specific groups. Further surveys are required to encompass additional recreational groups as they emerge and to capture regional differences.

A current aim of research in this field is the collection of a trans-national survey over a complete winter season to allow a reliable calculation of morbidity and mortality in these sports.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

Brugger, H., Etter, H.J., Zweifel, B., Mair, P., Hohlrieder, M., Ellerton, J., Elsensohn, F., Boyd, J., Sumann, G., and M. Falk, 2007: The impact of avalanche rescue devices on survival. *Resuscitation*, **75(3)**, 476–483.

Brugger, H., Staffler, H.P., Aberer, A., Castlunger, L., and G. Strapazzon, 2010: Vollerhebung Schitourengeher in Südtirol. *Bergundsteigen*, **4**, 58–61.

Etter, H.J., Stucki, T., Zweifel, B., and C. Pielmeier, 2008: Developments in Avalanche Forecasting and Other Prevention Measures and Their Potential Effects on Avalanche

Fatalities. *Proc. Int. Snow Sci. Workshop*, Whistler, BC.

Haegeli, P., Falk, M., Brugger, H., Etter, H.J., and J. Boyd, 2011: Comparison of avalanche survival patterns in Canada and Switzerland. *CMAJ*, **183(7)**, 789–795.

Hohlrieder, M., Brugger, H., Schubert, H., Pavlic, M., Ellerton, J., and P. Mair, 2007: Pattern and severity of injury in avalanche victims. *High Alt. Med. Biol.*, **8-1**, 56–61.

Silverton, N.A., McIntosh, S.E., and H.S. Kim, 2007: Avalanche safety practices in Utah. *Wilderness Environ. Med.*, **18(4)**, 264–70.

Silverton, N.A., McIntosh, S.E., and H.S. Kim, 2009: Risk assessment in winter backcountry travel. *Wilderness Environ. Med.*, **20(3)**, 269–74.

Zweifel, B., Ræz, A., and T. Stucki, 2006: Avalanche risk for recreationists in backcountry and off-piste area: surveying methods and pilot study at Davos, Switzerland. *Proc. Int. Snow Sci. Workshop*, Telluride, CO.