ATTRIBUTES OF AVALANCHE AIRBAG OWNERS – INSIGHTS FROM THE EUREGIO AND SWISS AVALANCHE FORECAST RESEARCH PANELS

Eeva Latosuo*, and Pascal Haegeli

Avalanche Research Program, Simon Fraser University, Burnaby BC, Canada

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We are using information from the Euregio and Swiss avalanche forecast research panels that includes detailed questions on recreational and professional activities in avalanche terrain, personal motivations and backgrounds, and avalanche safety practices including the use of safety equipment. Sample is likely biased toward committed recreationists, also expected more engaged in avalanche safety practices.

Focusing on research panel members with complete signup information (n=6277), we find that approximately one in three backcountry recreationists own an airbag (36.9%, n=2317). This result asserts that avalanche airbags have become a common risk management tool, but not a safety standard among recreational backcountry users.

Our univariate analysis describes attributes to owning an airbag for the participants in our sample. Males own more airbags than females. Out-of-bounds skiers have higher proportion of airbags than participants in other activities, such as backcountry skiers or snowshoers. The committed recreationists who engage in the activities more than 11 days a winter own more airbags than people who participate in the activity less frequently. Similarly, the most aggressive skiers own more airbags than participants who prefer mellower terrain.

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KEYWORDS: avalanche airbag, user research, Europe

1. INTRODUCTION

Avalanche airbags can increase survival in avalanche involvements by preventing a critical burial or decreasing burial depth. Research has evaluated the effectiveness of this safety device for mortality reduction (Haegeli et al., 2014; Di Stefano et al., 2022) and their impact on risk attitudes and behavior (Haegeli et al., 2020), but information is sparse on quantifying airbag ownership among the winter backcountry recreationists. Both Ng et al. (2015) and Lane and McIntosh (2023) used small convenience samples from trailhead intercepts in the Wasatch and the Tetons. In Ng's estimation, 5% of backcountry travelers own airbag (n=193); in 2022, Lane and McIntosh estimated 22% (n=144). The most comprehensive perspective to date has been provided by Procter et al. (2014), who surveyed avalanche safety equipment use among recreationists (n=5576) in Northern Italy in 2011. Their analysis showed that less than 4% of recreationists used avalanche airbags. However, there have been substantial developments in this space over the last 12 years, and the goal of our work is to provide an up-to-date perspective on the prevalence of airbag use and the characteristics of airbag users.

* *Corresponding author address:*
Eeva Latosuo, Simon Fraser University, Burnaby, BC, Canada;
email: eeva_latosuo@sfu.ca

2. METHODS

2.1 Data source

We used the information from the Euregio and Swiss avalanche forecast research panels (Haegeli et al., 2023), two large databases that consist of avalanche forecast users interested in regularly participating in avalanche safety

research. The signup survey for these research panels includes detailed questions on recreational and professional activities in avalanche terrain, personal motivations and backgrounds, formal avalanche safety training, and avalanche safety practices including the use of safety equipment. The information about the use of safety equipment was gather with the simple question *"Which of the following safety equipment items do you typically bring into the backcountry in the winter?"* and participants answered the question by clicking on a series of checkboxes for the following types of gear: avalanche transceiver, avalanche shovel, avalanche probe, first aid kit, mobile phone, other (emergency) communication device (radio, satellite messenger of phone), avalanche airbag, and helmet. This dataset provides a useful data source for evaluating how widespread the avalanche airbag use is among backcountry travelers. Reader interested in a more detailed description of the signup questions for the research panel are referred to Haegeli et al. (2023).

To describe panel members' general exposure to avalanche hazard, we use the terrain preference classification presented by Neweduk and Haegeli (2023). This classification divides our sample in five groups according to the participants' self-stated preference for different avalanche terrain exposure classes (Statham and Campbell, 2023). In this paper, we refer to the derived exposure classes with terms preference for 'the most challenging terrain', 'challenging terrain', 'moderate terrain', 'conservative terrain' and 'the most conservative terrain'.

2.2 Data analysis

We used Pearson's chi-squared tests and Wilcoxon rank sum tests to examine the relationship between airbag use and various participant characteristics (e.g., age, gender, activity type and terrain preference) individually. In addition, we used conditional inference trees (CTrees; Hothorn et al., 2006) to explore these relationships in a multivariate way to get a better understanding of the importance of the different relationships and their interactions. Ctrees are a statistical classification tree algorithm that recursively partitions a dataset into smaller and smaller subgroups along splits in the predictor variables that produce children nodes whose distribution of the response variable are maximally different from each other (Hothorn et al., 2006). The splitting process repeats until the algorithm can no longer find any statistically significant relationship according to the specified p-value threshold (default value: 0.05). Once the splitting process is complete, the terminal nodes at the end of each branch contain a distribution of the dependent variable that exhibits minimal variation within the node and maximum variation to the immediately adjacent neighboring node. All data analysis was conducted in the R statistical environment (R Core Team, 2023), and we used the ctree function from the partykit package (Hothorn and Zeileis, 2015) for the ctree analyses.

2.3 Data set

The dataset for the present analysis consists of 6277 research panel participants who completed the full signup survey and answered the airbag use question. This sample excludes avalanche professionals who work more than 10 days each winter managing avalanche risk for others (e.g., mountain guides, ski patrollers). Eighty percent of the sample identifies as male, 20% as female. Majority of respondents are 25-34 years (32.6%), and 74% fall into the age range of 25-54 years. The primary backcountry activity within the sample is backcountry skiing or riding (79.5%) followed by out-of-bounds (OB) skiing (11.3%). In this paper, we refer to both skiing and snowboarding with the term skiing. Our sample is divided almost evenly between different classes of years of backcountry experience in total: 2-5 years (25.8%), 6-10 years (22.9%), 11-20 years (22.7%), and 20+ years (26.7%). Majority of our sample (40.6%) are committed recreationists who go out 21-50 days a winter and a third spends 11-20 days pursuing backcountry activities each winter. Our sample has a good representation of Swiss (34.7%), German (26.1%), Austrian (25.6%), and Italian (11.6%) recreationists.

Half of our sample seeks out challenging terrain exposure. In this paper, we refer to the derived terrain classifications with terms preference for 'the most challenging terrain' (population share: 20.4%), and 'challenging terrain' (31.6%), 'moderate terrain'(22.7%), 'conservative terrain'(16.5%) and 'the most conservative terrain'(8.8%) .

3. RESULTS

We find that approximately one in three backcountry recreationists in our sample use an airbag when they travel in the backcountry (36.9%, n=2317). This result asserts that avalanche airbags have become a common risk management tool, but not a safety standard

among all recreational backcountry users. However, due to the self-selection bias of the panel membership, our sample is likely biased toward recreationists that are committed to their activity; the sample is also presumably more engaged in avalanche safety. Hence, the percentage of airbag users is likely lower in the general winter backcountry recreation population.

3.1 Airbag use characteristics

We explored three demographic variables (gender, age category, and country of residence) and five recreation variables (activity type, years of experience, days of activities per year, and preferred terrain exposure) using univariate approaches.

Airbag use is significantly less prevalent among female recreationists than males (chi-squared test: p-value <0.0001). Owning an airbag is more common in the age group of 35-44-years-old and less common in the youngest and the oldest age groups (chi-squared test: p-value < 0.0001). Austrian and German recreationists use airbags more than other nationalities (chi-squared test: p-value < 0.0001).

Out-of-bounds skiers own more airbags than recreationists that prefer other activity types (chi-squared test: p-value < 0.0001). The participants with less than six years of experience had lower proportion of airbags (chi-squared test: p-value < 0.0001). The more days per year participant spends in the backcountry, the higher the proportion of airbag use (Wilcoxon rank sum: p-value < 0.0001).

The skiers that prefer challenging terrain use airbags more than those who seek out more conservative terrain options (Wilcoxon rank sum test: p-value <0.0001).

3.2 Multivariate relationship and airbag use

For the multivariate conditional inference tree analysis, our sample consists of those participants who completed the terrain preference questions, n=1779. The subsample focuses on three activity types (out of bound skiing, backcountry skiing, and snowshoeing) and four countries of residence (Switzerland, Austria, Germany and Italy).

We explored the multivariate relationships of activity type, gender, age category, country of residence, years of experience, days per year recreating, and terrain preference classes using the conditional inference tree analysis. The CTree analysis proposes significant relationships and interactions between the eight chosen characteristics of airbag ownership within our subsample. (Fig.1).

Recreational activity is the primary factor related to airbag use. Our results suggest that out of bounds skiers have the highest proportion of airbag use overall. Out of bounds skiers who engage in their activity more than 11 days use airbags much more (63.3%) than less committed OB skiers. Among the backcountry skiers and snowshoers, country of residence is the next defining split. Panel members from Austria and Germany have a higher proportion of airbag use than Swiss or Italians. The next splitting factor is terrain use preference; skiers who prefer more challenging terrain use airbags more than those who prefer less exposed terrain.

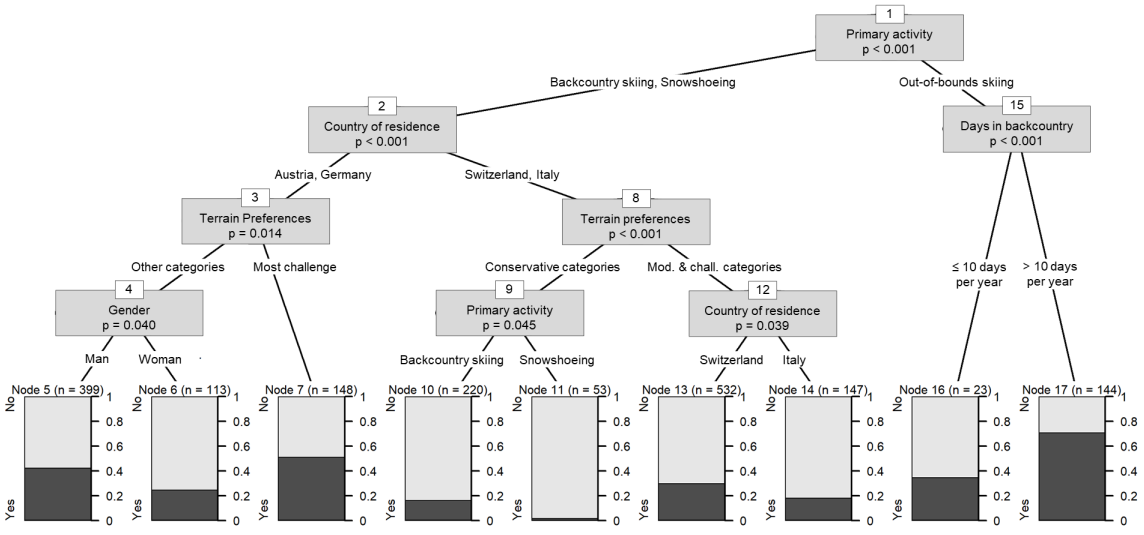

Figure 1: Conditional inference tree analysis of the airbag use attributes among the Euregio and Swiss avalanche research panel participants.

4. DISCUSSION

Our analysis suggests that up to one third of backcountry recreationists in Switzerland and the Euregio regions carries one. Backcountry activity type is the main attribute for choosing to use airbag. Out-of-bounds skiers have higher proportion of airbags than participants in other activities, such as backcountry skiers. Airbag use is the lowest amongst snowshoers. The committed recreationists who engage in the activities more than 11 days a winter use airbag more than people who participate less frequently. Similarly, the skiers drawn to more challenging terrain own more airbags than participants who prefer mellower slopes.

Avalanche airbag ownership has not reached the status of essential safety equipment in the winter backcountry. While up to one third of backcountry recreationists in our sample carries one, the true use in the population is likely lower due to the sampling bias of the research panel; our data are biased towards avid backcountry recreationists.

The preference for airbag use could depend on the local terrain characteristics; it would be interesting to further explore the relationship between geographically bounded terrain preferences and airbag ownership. The European sample does not include motorized users; it would be useful to learn more about the airbag use in this backcountry segment. There is also opportunity to do more research on the existing barriers for universal adoption, such as the cost of the equipment (Ng et al., 2015; Lane and McIntosh, 2023) and the issues of size and weight (Van Tilburg, 2021).

5. CONCLUSION

Our work provides insight on the prevalence of airbag use and the characteristics of airbag users drawn from a large European dataset. Of the backcountry recreationists in Switzerland and the Euregio region, roughly one in three uses an airbag (36.9%, n=2317). This result asserts that avalanche airbags have become a common risk management tool, but they have not been adopted as standard safety equipment for general recreational backcountry population.

The main attribute for airbag use is preferred activity type followed by terrain preference. The out-of-bound skiers who go out often and who enjoy more challenging terrain use airbags the most – in the group of the most committed OB skiers, who get out more than 21 days a winter, almost everyone carries an airbag.

The airbag ownership is dependent on the type of activity and terrain preferences of the user. The equipment is far from being adopted as a silver bullet for risk management practices; individual recreationists will continue to decide for themselves if the investment is appropriate for their backcountry adventures.

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