THE GERMAN ALPINE CLUB (DAV) SKI TOURING STUDY: HOW WELL DO SKI TOURING GROUPS KNOW THE AVALANCHE BULLETIN?

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ABSTRACT: The study investigated the comprehension and utilization of avalanche bulletins by ski touring groups in the Austrian Alps during the winters of 2019/20 and 2021/22. The avalanche bulletin, a critical tool for winter sports enthusiasts, provides essential information for assessing avalanche risk and planning safe tours. Despite its importance, the effectiveness of these bulletins hinges on users' ability to accurately interpret the information provided. This research surveyed 112 ski touring groups (345 individuals) across two popular ski touring locations, examining their understanding of avalanche danger levels, specific avalanche problems, and the identification of hazardous spots as detailed in the bulletin.

The study employed a comprehensive methodology, including pre- and post-tour surveys, terrain and risk analysis, and expert assessments to evaluate the participants' knowledge and decision-making processes. Results indicate a high level of awareness regarding general avalanche danger levels, with 91% of groups correctly identifying the current danger level. However, the accuracy diminished when it came to more complex information, such as specific avalanche problems and hazardous terrain features, with only 63.9% and 39.5% of groups, respectively, demonstrating full understanding.

Further analyses explored the correlation between bulletin knowledge and various group characteristics, such as size, experience, and equipment. Notably, larger groups and those with more frequent ski touring experience tended to have a better understanding of the avalanche bulletin. Additionally, the study found no significant relationship between bulletin knowledge and actual risk behavior in the field, suggesting that even well-informed groups might not always act in accordance with their knowledge.

The findings highlight a critical gap in the practical application of avalanche bulletin information, particularly at higher danger levels, where accurate knowledge of hazardous spots is crucial. The study suggests that ski touring groups may choose safer routes at higher danger levels, potentially explaining the observed decline in detailed bulletin knowledge. This research underscores the need for enhanced education and training to ensure that winter sports enthusiasts not only understand but also effectively apply the information provided in avalanche bulletins to mitigate risks in the field.

KEYWORDS: Avalanche bulletin knowledge, avalanche bulletin understanding, decision making, risk taking

1. INTRODUCTION

The current avalanche forecast (also known as bulletin) is the central source of information for selecting and planning itineraries under uncontrolled winter conditions. In addition to the avalanche danger rating as an initial rough indicator for the avalanche danger, the bulletin contains additional information that describes the danger situation in detail for ski tourers. Inter alia, with the help of the bulletin which presents the available information for a certain region in layers with increasing complexity (known as the information pyramid) (Morgan et al. 2023), users may find answers to the following questions:

- Is the avalanche danger divided by time of day or in terms of altitude?
- Which of the five avalanche problems have to be considered?
- Where are the hazardous spots (altitude, exposure, steepness & terrain) located?

Even with little avalanche knowledge, clear recommendations for tour selection can be derived from the avalanche bulletin following simple rules of thumb such as travelling in flatter terrain at higher danger levels and/or using probabilistic-based tools (e.g. reduction method, *Snowcard*).

For those with more avalanche knowledge, the additional information enables more differentiated tour planning, which - depending on the danger situation - makes it possible to access certain steep slopes even at higher danger levels.

A fitting strategy for avoiding an avalanche accident involves good tour planning, which includes the identification of hazardous spots, and appropriate behavior at these hazardous spots in the terrain. The avalanche bulletin provides the relevant information for

this. However, as avalanche bulletins summarize the conditions for a larger region, they must be supplemented by winter sports enthusiasts in the field with their own observations so that they can make a good decision at a specific hazardous spot. In the current research all 112 ski touring groups we surveyed were familiar with the avalanche situation report as a decision-making aid for assessing avalanche danger and all but one group stated that using the avalanche bulletin was their standard method for assessing avalanche danger (see Fritz et al. 1/2023).

The best bulletin is useless if users don't understand it or ignore it at all. For a long time, the sometimes very technical information contained in the avalanche bulletin was not examined in detail. It was implicitly assumed that everyone who read the information would also understand it. Only in recent years has the content of the avalanche bulletin become the subject of a separate branch of research within snow and avalanche research.

According to Morgan et al. 2023, research has first focused on the production of danger ratings which is prone to both incomplete data and interpretation and judgement of those who publish bulletins (cf. Hutter et al. 2021). Regarding the perception and use of danger scales, there's a growing body of literature examining the bulletin-user-interface (cf. Fisher et al. 2022a).

So far, most surveys examining the users understanding of the avalanche bulletin content were either based on theoretical decision situations (e.g. Haegeli et al. 2010) or, lately, conducted online (e.g. Engneset et al. 2018; Fisher et al. 2022b; Hallandvik et al. 2017). Others (e.g. Sykes et al. 2020) have combined survey data and GPS tracking in real world in a case study.

Avalanche bulletins consist of generalized information valid for large areas. On a single slope scale, conditions may differ from what is indicated in the report. That's why we strive to widen Syke et al.'s (2020) approach of method triangulation to an extended field study. This study includes also expert's assessment of probability of triggering a slope, the consequences of an avalanche on that slope and thus behavioral recommendations on this specific slope (such as keeping a distance).

This article focuses on the winter sport enthusiasts' detailed comprehension of the information of the avalanche bulletin by trying to find answers for the following research questions:

- Are groups aware of both the danger level and the additional information?
- Are there types of groups that know the avalanche bulletin better than others?
- What role does the bulletin play in the decision-making process?
- Which terrain and avalanche-related factors of the avalanche bulletin determine the hazard assessment of the groups and thus the recognition of hazardous spots?

2. METHOD

During the winters of 2019/20 and 21/22, the DAV Safety Research Department interviewed ski touring groups at two locations in the Austrian Alps, a total of 112 groups with 345 people at the parking lots of the two classic ski touring venues (Namlos in the Lechtal Alps and Kelchsau in the Kitzbuehel Alps).

2.1 Survey instruments and procedure of the group survey

To be able to examine the decision-making process well, as described above, the ski touring groups were first interviewed before the tour and at the end of the tour at the starting point or parking lot of the ski touring route. Only groups that could also be surveyed after the tour / descent are included in the following evaluations (= completed questionnaire 2). At the end of the second questionnaire (i.e. after returning from the tour), these groups were asked about the daily avalanche bulletin valid for the respective region. In more detail, they were asked about the danger level, a possible division of the level, the avalanche problem(s) and the location of the hazardous spots according to the report. In addition to the answers, the interviewers also noted whether the answers were correct or not and finally assessed the bulletin knowledge of the group on a 5-point scale (from not assessable to information reproduced correctly and in full).

2.2 Survey instruments and procedure for terrain and risk analysis

Beforehand, the typical ski touring routes were identified for these locations. There were 12 tours in Kelchsau and 15 tours or connections of tours in Namlos. For each tour / descent, further common descent and ascent variants were identified, which was more important for the Kelchsau location than for Namlos. So-called terrain analyses were prepared and completed before the start of the survey season by a mountain and ski guide at the location using a terrain and risk analysis form.

All relevant terrain points of the tour were identified, and the terrain-relevant features were described. All those features that could be clearly identified from the map material were reported: Run-out area, slope exposure, height, slope dimension, steepness, terrain description, vegetation and location. For each tour and each variant, the avalanche-relevant terrain points (also called terrain point model) were identified according to the so-called '30-degree-rule' (Perla & Martinelli, 1975) which classifies slopes between 30° and 40° of steepness as potential terrain suitable for

triggering cold, dry avalanches ('snow slabs'). We call them direct terrain spots when they had this minimum steepness of 30° over an area of at least 20x20 meters. Other potential critical terrain spots which are situated in the run-out-area of steeper slopes above the route were also included in the terrain model.

On the day of the survey itself, the risk analysis of the relevant terrain point was carried out. Therefore, the terrain points filtered in the terrain analysis were evaluated based on the current avalanche situation. The risk analysis listed all factors that were either variable in relation to snow and avalanches or could only be clearly assessed on site or through local knowledge. All observations and assessments were recorded using an additional form to assess the regional avalanche situation. This included the evaluation of the avalanche situation report for the specific region, considerations for the assessment of the relevant hazardous spots (e.g. alarm signs) and relevant information on the snowpack structure, including the snow profiles carried out.

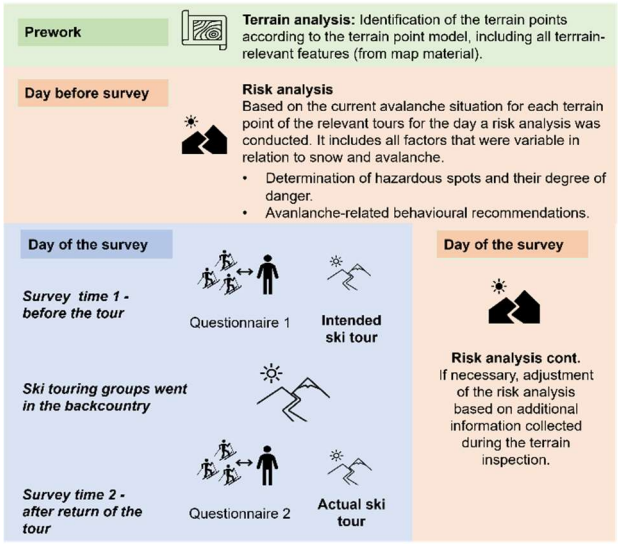

Figure 1: Study design of the 2019 to 2022 ski touring study.

The first step of the risk analysis consisted of an assessment of each terrain point according to the *Snowcard*. This involved determining whether or not the terrain point in question represented a hazardous point given the avalanche situation on that day. As a rule, the terrain corner data from the terrain analysis were used for this purpose. After the *Snowcard* analysis, the experts were asked to carry out the actual risk assessment based on the expert assessment and the terrain inspection with current information from the site. In the end, they derived a final risk assessment according to the Harvey et al. (2018) scheme, see **Fehler! Verweisquelle konnte nicht gefunden werden.**2. Finally, a four-stage behavioral recommendation was developed: Keep a distance, Single (including safety distance), Avoid the hazardous point, Do not continue the tour. A site that is not classified as a hazardous zone can be walked on as a group.

2.1 Survey instruments matching matrices

In order to compare the terrain points named by the groups from questionnaires 1 and 2 with those from the terrain and risk analysis, matching matrices were created. These matching matrices summarize all relevant data of the terrain and hazardous spots of the intended tour (survey time 1) and the actual ski tour (survey time 2). These data were then used to calculate the risk parameters such as risk potential, risk assessment and risk behaviour for the intended and actual tours. As a result, group data, terrain data and snow data could be displayed against each other, e.g. correlations or regressions could be calculated, etc.

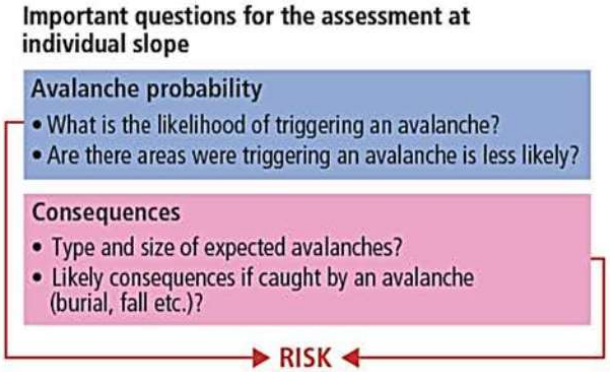

Figure 2: Risk on the individual slope as a result of the intersection of probability of triggering and consequences according to Harvey et al., 2018.

3. RESULTS

On average, the groups had 3.08 members (SD = 1.94). Most skiers toured with friends or buddies (46%) or family (38%), with only nine individuals skiing alone. More than half of the groups (60%) skied together regularly or very frequently, indicating strong familiarity among group members. 61% were gender-heterogeneous groups (n = 68), 35% were male-only groups (n = 39), and 4% were female-only groups (n = 5). The average age of participants was 42.55 years (SD = 11.34).

Additionally, 21% of the participants reported having no avalanche-related training. A practical avalanche transceiver course was completed by 38% of the groups, 20% received training from an Alpine club, and 10% had official expert training, such as from state-certified mountain guides or mountain rescue. The groups averaged 16 years of ski touring experience (SD = 10.26) and had completed an average of nine tours (SD = 6.10) during the current season. Their extensive ski touring experience was positively correlated with self-reported skills in avalanche risk competence (r_s = .27, p = .005).

An avalanche transceiver was standard in emergency equipment, with 98% of respondents carrying one, followed closely by probes and shovels, each at 97%. At the group level, 92% were fully equipped with avalanche safety gear.

The ski touring groups generally opted for frequently traveled tours, with approximately 850 to 1200 meters of vertical ascent. These tours navigated terrain that required stable and proficient skiing skills and included sections that could become hazardous during avalanches. About 91% of the tours were undertaken under “moderate” or “considerable” avalanche danger levels, aligning with the long-term danger profile of Switzerland's 10-year avalanche distribution (WSL SLF 2024).

3.1 Knowledge of the avalanche danger level (ADL)

Almost 91% of the groups knew the correct danger level of the daily avalanche condition report, which is a huge improvement compared to previous European studies (Schwiersch et al., 2005: just under 66%; Procter et al., 2014: 52.5%).

Furthermore, knowledge of the danger level increased with the height of the danger level: if it was more dangerous, the groups knew better which danger level the avalanche situation report indicated for the day. The difference in the proportion of correct answers from danger level 1 to danger level 3 was 14.1% (83.3% vs. 97.4%). Note that no surveys were carried out at danger level 4.

	Ski touring groups (*N* = 86)		**Kelchsau (*N* = 45)**		**Namlos (*N* = 41)**	
	n	%	*n*	%	*n*	%
ADL	78	90.7	42	93.33	36	87.80
Danger level 1	5	83.3	5	83.3	-	-
Danger level 2	36	85.7	12	85.7	24	85.7
Danger level 3	37	97.4	25	100	12	92.3

Tabel 1: Number of correctly named danger levels by location and danger levels on survey days. Note: No surveys were carried out at danger level 4.

3.1 Knowledge of split danger levels and division criterium of the risk level

Overall, the ski touring groups‘ knowledge rate of a divided danger level was 80.2%. Furthermore, knowledge of the danger level increased with the height of the danger level: When it was more dangerous, the groups tended to know better which danger level classification the avalanche bulletin gave. Knowledge of the danger level increased significantly from level 1 to level 3, $\chi^2(2) = 12.61$, $p = .002$.

	Ski touring groups (*N* = 86)		**Kelchsau (*N* = 45)**		**Namlos (*N* = 41)**	
	n	%	*n*	%	*n*	%
All ADL	69	80.2	38	84.4	31	75.6
Danger level 1	4	66.7	4	66.7	-	-
Danger level 2	28	66.7	10	71.4	18	64.3
Danger level 3	37	97.4	24	96.0	13	100

Table 2: Number of correctly named possible divisions of the danger level by location and danger level on survey day. Note: No surveys were carried out at danger level 4.

3.2 Knowledge of the avalanche problem(s)

Nearly two thirds of all groups (63.9%) were able to fully describe the avalanche problems mentioned in the avalanche bulletin either as stated in the overall report or as shown in the pictogram. There was no difference between the two single ski touring locations, χ^2 (3) = 4.23, p = .238. Yet again, the knowledge of avalanche problems increased significantly with the danger level, χ^2 (6) = 13.03, p = .042.

Avalanche problems (LP)	**Ski touring groups (*N* = 86)**		**Kelchsau (*N* = 45)**		**Namlos (*N* = 41)**	
	n	%	*n*	%	*n*	%
All ADL						
AP Not known	7	8.1	5	11.1	2	4.9
AP Partly known	24	27.9	10	22.2	14	34.1
AP Fully known	55	63.9	30	66.7	25	61.0
Danger level 1						
AP Not known	2	33.3	2	33.3	-	-
AP Partly known	-	-	-	-	-	-
AP Fully known	4	66.7	4	66.7	-	-
Danger level 2						
AP Not known	4	9.5	2	14.3	2	7.1
AP Partly known	15	35.7	5	35.7	10	35.7
AP Fully known	23	54.8	7	50.0	16	57.2
Danger level 3						
AP Not known	1	2.6	1	4.0	4	30.8
AP Partly known	9	23.7	5	20.0	-	-
AP Fully known	28	73.7	19	76.0	9	69.2

Table 3: Number of correctly named avalanche problems mentioned in the avalanche bulletin by danger level on the survey day and by location.

3.3 Knowledge of hazardous spots

The hazardous spots with regard to height, aspect, terrain form and steepness mentioned in the avalanche were coded individually in the questionnaire. Information on exposure was most likely to be reported correctly by all groups (51.2%), information on

steepness least often (24.4%). Information about height was correctly mentioned by 43% and terrain form 39.5%. On average the complete knowledge on average was only just under 40% (39.53% to be precise).

Looking at the knowledge of the hazardous spots separately according to the danger level on the day of the survey, there is a decrease in the average complete knowledge of the hazardous spots from level 2 to level 3 (M_{level2} = 37.25%, M_{level3} = 26.00%). Figure 3 shows the decline in complete knowledge.

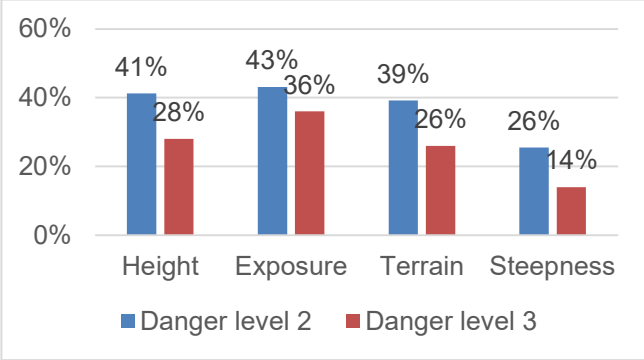

Figure 3: Complete knowledge of the ski touring groups to the hazardous spots mentioned in the avalanche bulletin at levels 2 and 3.

3.4 *Assessment of avalanche bulletin knowledge by the interviewers*

After reporting the individual questions on the avalanche bulletin, the interviewers assessed the group's knowledge of the report on a five-point scale (1 = not assessable or no information to 5 = complete). Overall, the avalanche bulletin knowledge of all groups was assessed as largely complete (45.3%) or complete (18.6%). In one fifth (22.1%) of the groups, knowledge was assessed as incomplete, and in 8.2% of the groups as not existent. If those ski touring groups, whose avalanche situation report knowledge could not be assessed by the interviewers (n = 7), are excluded from the data, then the knowledge of almost three quarters of the groups was complete (49.4%) or largely complete (24.10%).

3.5 *Score of avalanche bulletin knowledge*

To have a summarized value for the knowledge of the information in the avalanche bulletin, a score was calculated from the answers given as follows: No points were awarded for missing or incorrect answers. Furthermore, no distinction was made as to whether the additional information in the avalanche bulletin was given spontaneously or only when asked. The correct naming of the danger level and the correct knowledge of a split danger level were each awarded one point. Partial knowledge of the avalanche problem(s) mentioned in the bulletin was awarded half a point, full knowledge (regardless of whether known from pictogram or text in the report) was awarded one point. Knowledge of the hazardous spots was awarded a maximum of 2 points. Half a point was awarded for correct naming of height, aspect, terrain shape and steepness, and a quarter of a point for partial naming. Accordingly, a minimum of 0 points (no knowledge of the current avalanche bulletin) and a maximum of 5 points (= complete knowledge of the current report) were awarded for the calculation of the score.

Ski touring groups		Kelchsau		Namlos	
	n	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)
All ADL	86	70.39 (22.78)	45	67.67 (20.07)	41	73.30 (25.34)
Danger level 1	6	59.12 (28.71)	6	59.12 (28.71)	-	-
Danger level 2	42	67.14 (26.85)	14	61.07 (22.29)	28	70.18 (28.75)
Danger level 3	38	75.66 (14.85)	25	73.40 (14.84)	13	80.00 (14.43)

Table 4: Relative avalanche bulletin knowledge score by location and danger level on the survey day.

Next, the avalanche bulletin knowledge score was converted into percentages (relative score) and a categorical score according to quantiles. To assess the quality of the data collected on avalanche knowledge, the relative score was correlated with the interviewers assessment. Results showed a positive correlation between the relative knowledge score and the interviewers assessment, $r(106) = .76$, $p < .001$. Due to the high level of agreement, the following analyses were calculated with the bulletin knowledge score without taken the interviewer assessment into further account. Overall, all groups across all hazardous spots had a relative avalanche bulletin knowledge score of just over 70% (exact: 70.39%). Furthermore, their knowledge increased with the danger level (see Table 4).

3.6 Relationships between avalanche bulletin knowledge score and risk potential or risk behaviour

A number of correlations with the avalanche bulletin knowledge score were calculated separately according to the respective avalanche danger level on the day of the survey. Neither there were significant correlations of the avalanche bulletin knowledge score with the risk potential of the intended and actual tour, nor the hazardous spots of the intended and actual tour or the appropriate, cautious and risky behavior.

Ski touring groups at danger level 3 chose tours with a higher risk potential compared to level 2 and behaved more inappropriately at hazardous spots, but the knowledge or lack of knowledge of the avalanche bulletin in general or the hazardous spots mentioned in it in particular does not seem to be related to this.

3.7 Which ski touring groups do have a better knowledge of the avalanche bulletin?

In order to be able to assess which group variables are related to the avalanche bulletin knowledge score, correlation coefficients (Pearson correlations) were calculated between the score and the following variables in a first step: Group size, gender of the group, average age of the group, level of training, ski touring experience in years, ski touring experience according to ski touring frequency, type of group, proportion of avalanche transceivers in the group, proportion of probes in the group, proportion of shovels in the group, proportion of complete standard equipment, proportion of emergency call equipment, proportion of analog map, proportion of digital map, proportion of GPS, proportion of tour description, proportion of first aid, proportion of bivouac sack, proportion of helmet, group assessment of avalanche danger, group assessment of willingness to take risks, kilometers of approach, frequency of being on the tour together, and avalanche bulletin indicated as a decision-making aid.

In a second step, all variables that showed at least a marginally significant correlation ($p < .10$) either across all danger levels or at danger level 2 or 3 were included in linear regression models as predictors for the avalanche bulletin knowledge score (selected variables: Group size, level of training, ski touring experience according to ski touring frequency, proportion of emergency call resources, proportion of analog map, proportion of first aid, proportion of bivouac sack, kilometers of approach, frequency of being on tour together & avalanche bulletin as a decision aid).

When all variables were included and all avalanche danger levels were considered simultaneously, there was no significant model, $F(10, 26) = 1.85$, $R^2 = .19$, $p = .101$. For avalanche danger level 2, there was a significant model, $F(10, 26) = 3.07$, $R^2 = .36$, $p = .011$, with the significant predictors group size ($p = .041$) and distance traveled ($p < .001$; negative correlation). There was no significant model for avalanche danger level 3, $F(10, 26) = 1.85$, $R^2 = .19$, $p = .101$.

With stepwise inclusion of only those variables that contributed significantly to the variance explanation, a significant model, $F(2, 77) = 4.30$, $R^2 = .08$, $p = .017$, with the significant predictors proportion of analog map ($p = 0.34$) and frequency of being on tour together ($p = .045$; negative correlation) was found when all avalanche danger levels were considered simultaneously. Danger level 2 showed a significant model, $F(3, 33) = 8.43$, $R^2 = .38$, $p < .001$, with the significant predictors group size ($p = .048$), proportion of analog map ($p = 0.25$) and kilometers of travel ($p < .001$; negative correlation). For danger level 3, there was also a significant model, $F(1, 35) = 4.91$, $R^2 = .10$, $p = .033$, with the significant predictor frequency of being on tour together ($p = .033$; negative correlation).

3.8 Which ski touring groups have full knowledge of the hazardous spots?

As the knowledge of the information on the hazardous spots mentioned in the avalanche bulletin decreased from avalanche danger level 2 to level 3, possible group characteristics that could cause this effect were examined in addition to the bulletin knowledge score. For this purpose, various analyses (one-way ANOVAs, correlations, regression models) were carried out across all avalanche danger levels and separately by level. Overall, only a few significant predictors were found. For the hazardous spots in altitude, ski tour groups who were fully aware of this information differed from groups who were not or not fully aware of the information in terms of their competence in assessing avalanche hazards (self-assessment), $F(2, 80), 6.99$, $p = .002$, $\eta^2 = .15$. For the hazardous spots regarding exposure, the groups also differed in their competence in assessing avalanche hazards (self-assessment), $F(2, 80), 3.57$, $p = .033$, $\eta^2 = .08$ and in their willingness to take risks (self-assessment), $F(2, 72), 4.45$, $p = .015$, $\eta^2 = .11$ (negative correlation). This means that groups who were fully aware of the information on exposure rated themselves as more competent in assessing avalanche hazards and less willing to take risks than groups who were not or only partially aware of this information. There were no meaningful, significant differences between the groups for the terrain shape and steepness of hazardous spots (note: groups that were fully aware of the information on the four danger aspects of hazardous spots (height, aspect, steepness, terrain shape) usually also had a higher proportion of analog maps than groups that were not or only partially aware of this information). A higher level of training and years of ski touring experience only marginally explained the differences (i.e. $0.05 < p < .10$).

4. INTERPRETATION

Due to the greater relevance of the information on the hazardous spots for assessing the avalanche danger at higher avalanche danger levels, better knowledge would have been expected. The decrease in knowledge of the hazardous spots from danger level 2 to danger level 3 is questionable in that this knowledge is particularly relevant for level 3 for a well-founded assessment of the avalanche danger in the terrain. A possible ad hoc explanation would be that the ski tour groups at level 3 decide from the outset to only go on a tour with low risk potential (e.g. no slopes over 30 degrees). This assumption was checked using t-tests. The risk potential (here: Risk potential with passed hazardous spots) of the tour undertaken was about the same for level 3 (M = 5.76, SD = 4.58) as for level 2 (M = 5.71, SD = 4.35), the difference was not significant, $t(78) = 0.14$, $p = .44$. However, the group's risk management was less appropriate at level 3 (M = 6.08, SD = 3.34) than at level 2 (M = 7.31, SD = 2.93), $t(76) = 1.73$, $p = .044$, d = 0.89, and tended to be riskier (level 3: M = 21.16, SD = 19.80; level 2: M = 17.59, SD = 17.37), $t(76) = 0.85$, $p = .199$, $d = 0.08$. This means that the ski touring groups behaved inappropriately more often at hazardous spots at level 3 (e.g. not keeping a distance between group members).

These results can only be compared indirectly with the first ski touring study by the DAV safety research (see Schwiersch et al., 2005). In the first study, the assessment of the comprehensibility of the bulletin by the ski tourers was surveyed (absolutely comprehensible = 51.6%; comprehensible = 36.9%; partially comprehensible = 6.6%; difficulties in understanding = 4.1%; completely incomprehensible = 0.6%), the knowledge of the valid danger level (almost 66% correct answers) and the assessment of the knowledge of the additional information of the bulletin by interviewers (complete & correct answer = 7%; incomplete answer = 27%; no answer = 66%). In a comparison of the two studies, knowledge of the hazard level increased only slightly (Δ = 4%), but knowledge of the additional information increased significantly (complete knowledge of the additional information of the ski touring groups across all hazard levels: 61.21%; Δ = 54.21%).

5. CONCLUSION

Overall, knowledge of the contents of the current avalanche bulletin increases with the avalanche danger level. At level 3, the ski touring groups know approx. 75% of the contents (according to the weighted, relative avalanche bulletin knowledge score). However, this knowledge is essentially based on knowledge of the avalanche danger level, the division criteria and the avalanche problems. It is extremely worrying that the knowledge of the information on the hazardous spots (altitude, exposure, steepness, terrain shape) required to assess the avalanche danger in the terrain decreases from danger level 2 to level 3. This lack of knowledge of the hazardous spots is not reflected in a more defensive behavior of the ski tour groups: Rather, the ski tour groups at level 3 tended to undertake tours with a higher risk potential compared to level 2 and behaved inappropriately at hazardous spots more often.

Overall, the data neither support nor contradict the assumption that ski touring groups at level 3 know less information about the hazardous spots mentioned in the avalanche bulletin because they choose tours with a lower danger potential anyway. The hazard potential of the tours was the same for level 2 and level 3. Due to the greater number of hazardous spots at level 3, the risk potential of the tours also increased. An equally high average risk potential of the tours at level 2 and level 3 therefore tends to indicate that the ski tour groups chose their tours more defensively at level 3.

The lower level of knowledge of the information on the hazardous spots mentioned in the avalanche bulletin fits in with the overall result of the current study that the groups had not worked through and identified the individual hazardous spots of the tour spot by spot when planning the tour. Rather, they plan more holistically in the sense that they assess a tour's feasibility given the current avalanche situation as a whole and then there may still be one or two critical spots (in the sense of "the crossing up there"), which are also recorded rather roughly. Accordingly, the most relevant information in the bulletin for this form of tour planning is the danger level, the dividing criteria, the avalanche problems and possibly the exposure. This was the information that the groups knew best.

Finally, it can also be argued that from the danger level, the division criteria (esp. altitude level), the avalanche problems and the exposure (which one also knows anyway if one has followed the weather conditions to some extent), one can infer the further details on the aspects of the hazardous spots in the bulletin. Since this part of the study explicitly asked about knowledge of the current avalanche bulletin, we cannot conclude from not knowing the information about the named hazardous spots that the groups had no action-related idea of the hazardous spots in the terrain. Or to put it another way: If it is blowing from the west during a fresh snowfall and the avalanche bulletin issues a level 3, then I know, even without further information from the bulletin, that I need to be careful above the tree line on steeper slopes close to crests and in gullies and hollows. However, if someone asks me about the avalanche bulletin on site, I may not be able to provide all the information about the hazardous spots mentioned there.

Overall, the main problem for ski touring groups seems to be the transfer of knowledge to the individual slope, both in terms of the background knowledge distilled from the avalanche bulletin and on site. The according tools which help to do this transfer have now been published for several years and are being taught in trainings. As their application is obviously not being done sufficiently, the question arises as to other methods or tools that can do this better.

Regarding the results, which groups have worse or better knowledge of the avalanche bulletin, the different model calculations do not clearly identify any variables that predict avalanche bulletin knowledge. Rather, a mixed picture emerges. However, larger groups seem to confirm the assumption that "more people know more". And travelling together frequently seems to favor carelessness regarding dealing with the current conditions in tour planning. The negative correlation between travel distance and avalanche bulletin knowledge is astonishing. One would expect groups that take on a longer journey to find out about the conditions in advance. These results are consistent with the results of the first ski touring study of the DAV safety research (see Schwiersch et al., 2005) in that no clear variables for the knowledge of the danger level of the avalanche bulletin could be identified at that time either.

The results concerning full knowledge of the hazardous spots are again consistent with the results of this study (see Schwiersch et al., 2005) in that a correlation was also found then between self-assessed competence in the application of snow and avalanche knowledge and knowledge of additional information.

To conclude, it can be stated that the avalanche bulletin as a source of information and decision-making aid was not only known to all ski touring groups but was also mentioned as the standard method (98.8%) by all but one group. This is a significant increase compared with the first ski touring study by the DAV Safety Research Department (cf. Schwiersch et al., 2005), in which 77.9% of the ski tourers surveyed rated the avalanche bulletin as indispensable (analogous to the standard method) and a further 18.9% ascribed great importance to it for their own tour planning (1.6% partial importance & 1.6% little importance). Thus, the bulletin and the danger scale are widespread knowledge, but the knowledge of the more detailed information needs to improve, particularly when conducting tours in risky conditions. At least according to our extensive field study, no empirical evidence for stereotypes like “Inexperienced groups may only know the danger level, but no further details” could be detected.

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