Factors associated with self-reported risk-taking behaviour on ski slopes

G Ruedl[1], E Pocecco[1], R Sommersacher[2], H Gatterer[1], M Kopp[3], W Nachbauer[1], M Burtscher[1]

[1]Department of Sport Science, University of Innsbruck, Innsbruck, Austria
[2]Austrian Ski Federation, Innsbruck, Austria
[3]Department of General Psychiatry, Medical University, Innsbruck, Austria

Correspondence to Dr Gerhard Ruedl, Department of Sport Science, University of Innsbruck, Fürstenweg 185, Innsbruck 6020, Austria; gerhard.ruedl@uibk.ac.at

Accepted 2 December 2009

ABSTRACT

Background In recent years, discussions have arisen about the potential influence of wearing a ski helmet on an increasing level of risk taking and higher speeds on ski slopes.

Objective To evaluate factors associated with self-reported risk-taking behaviour in recreational skiers and snowboarders.

Methods Speeds of skiers and snowboarders were measured with a radar speed gun and sex, age, nationality, height, weight and helmet use, used type of gear, self-estimated skill level and self-estimated fitness level were recorded. In addition, participants were asked if they considered themselves as cautious or risk-taking skier or snowboarder.

Results In total, 453 skiers (39.6 (14.8) years) and 74 snowboarders (26.4 (9.6) years) have been interviewed. A stepwise forward logistic regression model revealed five independent factors for a risk-taking behaviour on slopes. Adjusted OR and their 95% CI showed that risk takers were <40 years (OR 2.4, 95% CI 1.51 to 3.80), had a higher skill level (OR 2.1, 95% CI 1.25 to 3.50), were more likely males (OR 2.0, 95% CI 1.22 to 3.26), had a lower body mass index (22.8 vs 24.2) and skied with higher speeds (on average 53 vs 45 km/h) compared to cautious skiers.

Conclusion Risk-taking behaviour on ski slopes is associated with younger age, higher skiing ability, male sex, lower body mass index and on average higher speeds. Helmet use is not associated with riskier behaviour on slopes. In addition, helmet use has to be recommended because helmet use reduces the risk of head injuries among skiers and snowboarders.

In alpine skiing, the use of helmets reduces the risk of head injuries up to 60%.[1–3] Nevertheless, a controversial discussion took place regarding the potential influence of wearing a ski helmet on the level of risk-taking behaviour.[2 4 5] The so-called risk-compensation hypothesis is based on the assumption that safety appliances such as ski helmets or bicycle helmets cause a false sense of security in their users resulting in an increased risk-taking behaviour.[5 6] Sulheim *et al*[2] showed that skiers who reported themselves as risk takers were more likely to wear a helmet than skiers who viewed themselves as cautious skiers (43.3 vs 29.2%; odds ratio (OR) 1.48). In addition, winter sport participants wearing safety devices such as ski helmets, back protectors or wrist guards demonstrated a higher level of risk taking compared to those not using such devices.[7] Shealy *et al*[8] showed that the average speed on ski slopes was significantly higher for helmet users (46 km/h) compared to non-helmet users (41 km/h), while high speed is associated with severe injuries in alpine skiing.[9, 10] In contrast, in a study by Scott *et al*,[5] users of helmets reported that they skied at lower speeds and challenged themselves less than non-helmet users (OR 0.64). However, these authors used only perceived speed data and did not measure the speed directly with a radar speed gun. Other studies investigated to what extent risk taking and sensation seeking cause injuries in alpine skiing.[11–13] As an example, Goulet *et al*[13] compared uninjured skiers randomly selected on ski slopes, injured skiers and skiers observed on slopes while performing thrill-seeking manoeuvres (risk-taking group). Interestingly, results showed that injured skiers did not take more risk but were less skilled compared to uninjured skiers.[13] Yet no study has investigated speed measurements and self-reported risk-taking behaviour on alpine ski slopes. Therefore, the objectives of this study were to measure skiing speeds and to record self-estimated risk-taking behaviour.

MATERIALS AND METHODS

Skiers and snowboarders were observed in four typical ski areas on six different days in the Western part of Austria in the winter season 2008–2009. Speed measurements have been performed between 10:00 and 16:00 on slopes of medium difficulty because most injuries occurred on such slopes.[14] Steepness of the slopes was comparable within all four ski areas. As much as possible, speed data were obtained from consecutive skiers and snowboarders. One trained observer used a radar speed gun (speed watch, Sierzega, Thening, AUT) from a stationary location directly in the path of the skier. Discrete measurements were obtained as the skier or snowboarder approached. The recorded speed value (km/h) was the maximum speed attained during the period the individual was under observation. Via walkie-talkie the observer informed research assistants waiting at the bottom of the slope about the speed value of the measured person. Research assistants stopped the individuals and invited them to participate in the study. Inclusion criterion was an age >12 years according to Goulet *et al*.[13] Besides the age of participants, height, weight, nationality (Austrian, German, others), type of used gear (ski or snowboard), helmet use, the self-rating of being a cautious or risk-taking skier or snowboarder and the self-estimated skill level (expert, advanced, intermediated, beginner) were recorded according to Sulheim *et al*.[2 15] Information on the self-estimated physical fitness level (very good, good, average, poor, very poor) was gathered according to Urabe *et al*.[16] The study was performed in conformity with the ethical standards laid down in the 1975 Declaration of

Helsinki. Informed consent was obtained from all individuals before participating in this research. Parents gave informed consent for children. However, self-estimations regarding skill level and fitness level were obtained from the child itself.

Statistical analysis

Unpaired t tests and Mann–Whitney U test, as appropriate, were used to compare self-reported cautious and risk-taking people with regard to age, height, weight, body mass index (BMI) and speed values. χ^2 Tests were used to assess different frequencies between groups with regard to sex, age group, nationality, type of used gear, helmet use, skill level and fitness level.

According to the results of these analyses, factors with $p<0.1$ were additionally evaluated using a stepwise forward logistic regression analysis to estimate adjusted OR and their 95% confidence interval (CI). In addition, for multivariate analysis, we created two dichotomous variables with regard to age group (≤39 vs >39 years) and skill level (more skilled: expert/advanced vs less skilled: intermediate/beginner). All p values were two-tailed and values <0.05 were considered to indicate statistical significance.

RESULTS

In total, 527 skiers and snowboarders >12 years old agreed to participate in this study. Mean age of 453 recreational skiers and 74 recreational snowboarders was 39.6 (14.8) years and 26.4 (9.6) years, respectively. More than 90% of invited individuals agreed to participate. Of all participants, 369 (70%) considered themselves to be cautious on ski slopes and 158 (30%) classified themselves as risk-taking skiers or snowboarders. In table 1, distributions of demographic data of the two groups are presented. Cautious skiers were significantly older and had a higher BMI ($p<0.001$). Risk-taking skiers were more likely to be male ($p=0.003$), skied faster (on average 53 vs 45 km/h, $p<0.001$) and showed a higher level of skiing ability ($p<0.001$) than cautious skiers. A trend for a difference between groups with regard to physical fitness level ($p=0.075$) was shown. No significant differences were found with regard to nationality, used type of gear and helmet use ($p>0.1$).

Multivariate regression analysis revealed five of six variables to be significantly associated with risk-taking behaviour on ski slopes (table 2). Adjusted OR showed that risk-taking skiers were <40 years (OR 2.4, 95% CI 1.5 to 3.8), had a higher skill level (OR 2.1, 95% CI 1.3 to 3.5), were more likely to be male (OR 2.0, 95% CI 1.2 to 3.3), had a lower BMI and skied with higher speeds on slopes compared to cautious skiers. Self-reported fitness level was not shown to be a predictive factor for risk-taking behaviour on ski slopes in our multivariate analysis.

Table 1 Characteristics of factors associated with risk-taking behaviour

	Risk-taking skiers (n=158)	Cautious skiers (n=369)	p Value
Age (years)	30.4 (13.8), 13–71	40.9 (14.2), 13–77	<0.001
Height (cm)	175.2 (8.3), 155–193	174.5 (9.2), 151–197	0.314
Weight (kg)	70.5 (13.8), 35–106	74.2 (14.7), 40–120	0.036
Body mass index	22.8 (3.3), 12.9–31.6	24.2 (3.5), 16.2–37.0	0.000
Speed (km/h)	52.5 (12.9), 17–93	45.3 (14.3), 12–87	<0.001
Sex			
Male	114 [72.2]	216 [58.5]	
Female	44 [27.8]	153 [41.5]	0.003
Age group (years)			
13–19	37 [23.4]	23 [6.2]	
20–39	76 [48.1]	144 [39.0]	
40–59	41 [25.9]	166 [45.0]	
≥60 years	4 [2.5]	36 [9.8]	<0.001
Nationality			
Austrian	62 [39.2]	140 [37.9]	
German	79 [50.0]	178 [48.2]	
Others	17 [10.8]	51 [13.8]	0.630
Used type of gear			
Ski	131 [82.9]	322 [87.3]	
Snowboard	27 [17.1]	47 [12.7]	0.188
Helmet use			
Yes	93 [59.2]	219 [59.7]	
No	64 [40.8]	148 [40.3]	0.926
Missing	1	2	
Skill level			
Expert	16 [10.1]	31 [8.4]	
Advanced	116 [73.4]	205 [55.6]	
Intermediate	19 [12.0]	110 [29.8]	
Beginner	7 [4.4]	23 [6.2]	<0.001
Physical fitness			
Very good	31 [19.6]	48 [13.0]	
Good	74 [46.8]	169 [45.9]	
Average	49 [31.0]	128 [34.8]	
Poor	2 [1.3]	20 [5.4]	
Very poor	2 [1.3]	3 [0.8]	0.075
Missing		1	

Data are presented as means (SD), range or frequencies [%].

Table 2 Multivariate OR of factors associated with a more risky behaviour on ski slopes

Factor	OR multivariate	95% CI	p Value
Age group: ≤39 vs >39 years	2.40	1.51 to 3.80	<0.001
Skiing ability: More skilled vs less skilled	2.09	1.25 to 3.50	0.005
Sex: Male vs female	1.99	1.22 to 3.26	0.006
Body Mass Index: 22.8 vs 24.2	1.15	1.07 to 1.24	<0.001
Speed values: 52.5 vs 45.3 km/h	0.97	0.95 to 0.98	<0.001

DISCUSSION

The principal finding of this study was that helmet use was not associated with self-reported risk-taking behaviour on ski slopes. However, participants who take risks on slopes were <40 years, more skilled and were more likely to be male. In addition, risk-taking skiers and snowboarders had a lower BMI and skied on average 7 km/h faster compared to the more cautious group. Thus, the present study does not support the risk-compensation hypothesis according to ski helmet use.[5]

Our results show that 30% of participants considered themselves to be a risk-taking skier or snowboarder. Well in accordance, other studies reported a rate of 34% to 38% for skiers and snowboarders who classified themselves as risk takers.[2 5] In the study by Sulheim *et al*,[2] 43% of risk takers and 29% of cautious skiers used ski helmets, whereas we found an equal distribution of about 59% in both groups. In contrast, other studies showed a helmet rate of 12% to 35%.[2 5 7 17 18] The high helmet rate in this study might be due to an increase of helmet use in recent years in the Alps. In addition, Bürkner *et al*[7] showed recently that about 75% of interviewed skiers used a ski helmet.

Regarding mean speed, helmet users did not differ significantly at the preset α level ($p=0.062$) compared to non-helmet users (48 vs 46 km/h, data not shown). An a posteriori power calculation revealed a power of 60%. To find this difference to be significant, we would have needed a total sample of 1000 individuals. In comparison, Shealy *et al*[8] reported that the average speed of helmet users of 46 km/h was significantly higher than those not using a helmet at 41 km/h. However, they did not record skill level and risk-taking behaviour. Our results show that in helmet users the rate of more skilled skiers was significantly higher (76.9% vs 59.0%), whereas the distribution of risk-taking behaviour was nearly equal (29.8% vs 30.2%) compared to non-helmet users (data not shown). Therefore, we conclude that use of a helmet is not associated with a higher level of risk taking but with a higher skill level. In accordance to our result, Scott *et al*[5] found no evidence of risk compensation among the use of a helmet in skiers and snowboarders. In addition, in a study by

Hagel *et al*,[4] no evidence was shown that helmet use increased the risk of severe injury below the head and neck region.

In agreement with our result, Goulet *et al*[13] reported that skiers from a risk-taking group were significantly younger than injured skiers and uninjured controls. In addition, in the study by Bürkner *et al*,[7] the highest level of risk taking was seen in the age group from 16 to 20 years.

We found that a higher skill level was associated with risk-taking behaviour. Goulet *et al*[13] also reported that skiers from a risk-taking group were significantly more skilled than injured skiers and uninjured controls. Made and Elmqvist[19] reported in a 10-year study of snowboard injuries that the fall per run ratio in beginners was higher (1.0 vs 0.4) and their risk behaviour lower (3.9 vs 6.6 on a visual analogue scale from 1 to 10) compared with advanced snowboarders. In addition, advanced snowboarders had significantly fewer injuries compared with beginners.[19] Also, other studies showed higher injury rates for beginner skiers and snowboarders compared with experts.[20 21] However, types of activities or high-speed manoeuvres performed by expert skiers and snowboarders may increase the risk of sustaining a more severe injury compared with beginners.[22]

In the study by Goulet *et al*,[13] 71% of risk takers were males. Well in accordance, we found 72% males in the risk-taking group. In addition, Bürkner *et al*[7] reported that males showed a significantly riskier behaviour on ski slopes than females (7 vs 5 on an analogue scale from 0 to 10). Levy *et al*[23] reported that the risk of sustaining a head injury was 2.23 times greater for male compared to female skiers and snowboarders.

In this study, risk takers had a lower BMI than more cautious participants. This may be in part associated with a higher self-estimated physical fitness level because there was a positive correlation between BMI and fitness level (τ=0.176, p<0.001) for all participants. However, fitness level was not shown to be a predictive factor for a more risky behaviour on ski slopes in our multivariate analysis.

A few limitations have to be considered. According to Sulheim *et al*,[2] the question used to assess risk-taking behaviour has not been formally validated but seems to have face validity. From a psychological point of view, one might claim a psychometric instrument with sufficient validity and reliability for assessing risk-taking behaviour knowing that self-report to one question might lead to under-report or over-report of health-risk behaviours affected by cognitive and situational factors, especially in younger people.[24] Considering our assessment situation, future research should develop a short instrument to improve the assessment of risk-taking behaviour in real-life situations. Nevertheless, randomised controlled trials, the gold standard of study design, have to confirm our results.

What is already known about this topic

- Controversy exists whether helmet use increases the level of risk-taking behaviour and higher on slope speeds of skiers and snowboarders.

What this study adds

- Helmet use in downhill skiing is increasing in the Alps.
- Risk-taking skiers and snowboarders skied faster because they were more skilled.
- This study provides further evidence that helmet use does not affect self-reported risk-taking behaviour in recreational alpine skiing.

CONCLUSION

Risk-taking behaviour on ski slopes is associated with younger age, higher skiing ability, male sex, lower BMI and on average higher speeds. Helmet use is not associated with riskier behaviour on slopes. In addition, helmet use has to be recommended because helmet use reduces the risk of head injuries among skiers and snowboarders, as shown in many investigations.

Acknowledgements Speed measurements were financially supported by the Austrian Ski Federation.

Funding Austrian Ski Federation.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

Detail has been removed from this case description/these case descriptions to ensure anonymity. The editors and reviewers have seen the detailed information available and are satisfied that the information backs up the case the authors are making.

REFERENCES

1. **Hagel BE**, Pless IB, Goulet C, *et al.* Effectiveness of helmets in skiers and snowboarders: case-control and case crossover study. *BMJ* 2005;**330**:281–3.
2. **Sulheim S**, Holme I, Ekeland A, *et al.* Helmet use and risk of head injuries in alpine skiers and snowboarders. *JAMA* 2006;**295**:919–24.
3. **Mueller BA**, Cummings P, Rivara FP, *et al.* Injuries of the head, face, and neck in relation to ski helmet use. *Epidemiology* 2008;**19**:270–6.
4. **Hagel B**, Pless IB, Goulet C, *et al.* The effect of helmet use on injury severity and crash circumstances in skiers and snowboarders. *Accid Anal Prev* 2005;**37**:103–8.
5. **Scott MD**, Buller DB, Andersen PA, *et al.* Testing the risk compensation hypothesis for safety helmets in alpine skiing and snowboarding. *Inj Prev* 2007;**13**:173–7.
6. **Thompson DC**, Thompson RS, Rivara FP. Risk compensation theory should be subject to systematic reviews of the scientific evidence. *Inj Prev* 2001;**7**:86–8.
7. **Bürkner A**, Eichbichler A, Simmen HP. [Safety requirements and risk factors of skiers and snowboarders]. *Sportverletz Sportschaden* 2009;**23**:41–6.
8. **Shealy JE,** Ettlinger CF**,** Johnson RJ**.** How fast do winter sports participants travel on alpine slopes? *J ASTM Int* 2005**;2**:1–8**.**
9. **Takakuwa T,** Endo S**.** Factors determining the severity of ski injuries**.** *J Orthop Sci* 1997**;2**:367–71**.**
10. **Meyers MC**, Laurent CM Jr, Higgins RW, *et al.* Downhill ski injuries in children and adolescents. *Sports Med* 2007;**37**:485–99.
11. **Bouter LM**, Knipschild PG, Feij JA, *et al.* Sensation seeking and injury risk in downhill skiing. *Person Individ Diff* 1988;**9**:667–73.
12. **Cherpitel CJ**, Meyers AR, Perrine MW. Alcohol consumption, sensation seeking and ski injury: a case-control study. *J Stud Alcohol* 1998;**59**:216–21.
13. **Goulet C**, Regnier G, Valois P, *et al.* Injuries and risk taking in alpine skiing. In: Johnson RJ, Zucco P, Shealy JE, eds. *ASTM STP 1397, skiing trauma and safety.* Vol 13. West Conshohocken, Pennsylvania, USA: ASTM International, 2000:139–46.
14. **Burtscher M**, Sommersacher R, Ruedl G, *et al.* Potential risk factors for knee injuries in alpine skiers. *J ASTM Int* 2009;**6**:1–4.
15. **Sulheim S**, Ekeland A, Bahr R. Self-estimation of ability among skiers and snowboarders in alpine skiing resorts. *Knee Surg Sports Traumatol Arthrosc* 2007;**15**:665–70.
16. **Urabe Y**, Ochi M, Onari K, *et al.* Anterior cruciate ligament injury in recreational alpine skiers: analysis of mechanisms and strategy for prevention. *J Orthop Sci* 2002;**7**:1–5.
17. **Andersen PA**, Buller DB, Scott MD, *et al.* Prevalence and diffusion of helmet use at ski areas in Western North America in 2001–02. *Inj Prev* 2004;**10**:358–62.
18. **Buller DB**, Andersen PA, Walkosz BJ, *et al.* The prevalence and predictors of helmet use by skiers and snowboarders at ski areas in western North America in 2001. *J Trauma* 2003;**55**:939–45.
19. **Made C**, Elmqvist LG. A 10-year study of snowboard injuries in Lapland Sweden. *Scand J Med Sci Sports* 2004;**14**:128–33.
20. **Langran M**, Selvaraj S. Increased injury risk among first-day skiers, snowboarders, and skiboarders. *Am J Sports Med* 2004;**32**:96–103.
21. **Hagel B**. Skiing and snowboarding injuries. *Med Sport Sci* 2005;**48**:74–119.
22. **Goulet C**, Hagel BE, Hamel D, *et al.* Self-reported skill level and injury severity in skiers and snowboarders. *J Sci Med Sport* 2008.
23. **Levy AS**, Hawkes AP, Hemminger LM, *et al.* An analysis of head injuries among skiers and snowboarders. *J Trauma* 2002;**53**:695–704.
24. **Brener ND**, Billy JO, Grady WR. Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: evidence from the scientific literature. *J Adolesc Health* 2003;**33**:436–57.