A pilot case–control study of behavioral aspects and risk factors in Swiss climbers

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Background **Climbing is a popular sport in Switzerland, with approximately 100 000 active participants. There is an inherent risk of falls, overuse and stress-related trauma, with a reported injury rate of 4.2 injuries per 1000 climbing hours.**

Objective **Comparison of possible risk factors in patients and noninjured controls.**

Methods **A case–control survey was conducted. Climbers admitted to three trauma units between June and October 2008 were surveyed using a questionnaire evaluating nine potential risk factors. The same questionnaire was distributed to noninjured climbers during the same time period. Logistic regression was performed.**

Results **Fifty patients and 63 controls were included in this survey. Variables significant for patients were: more than 10 years versus less than 1 year of climbing experience (odds ratio: 5.34; confidence interval: 1.16–17.76; $P=0.006$) and no previous experiences of the climbing route (odds ratio: 2.72; confidence interval: 1.15–6.39; $P=0.022$). No statistical significance was detected for age, sex, difficulty level of the climbing route, warm-up, readiness for risk and abstinence from alcohol and drugs.**

Conclusion **Climbers with higher experience seem to be more prone to injuries. Larger studies on this subgroup are warranted, to identify typical risk profiles and to develop preventive strategies. Furthermore, climbers should be advised about the increased injury risk when trying new climbing routes and specific information should be given.** ***European Journal of Emergency Medicine*** **19:73–76 © 2012 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

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Introduction

What started as a traditional form of adventure has nowadays grown into a popular recreational and competitive activity, spreading rapidly across the globe. It has been estimated that in the USA, more than 300 000 people have climbed a rock wall (*http://www.hughston.com/hha/a.climb.htm*). The number of climbers, in general, is estimated to be much higher, given the size of the US country and opportunities for climbing there. In Switzerland, approximately 100 000 people regularly climb as a recreational sport (unpublished data, Swiss Alpine Club, 2010).

Climbing is a physically demanding sport, which allows only slight errors, with a reported injury rate of 4.2 injuries per 1000 climbing hours [1]. As a result, there has been a move to bring more awareness of the risks involved to beginners, novices, and expert climbers, in the hope of preventing injuries [2].

Climbing accounts only for one death in 320 000 climbs, compared with scuba diving with one death in 200 000 dives or hang-gliding with one fatal injury in 116 000 flights (*http://www.hse.gov.uk/education/statistics.htm*). Therefore, compared with other recreational activities, climbing sports have a lower injury incidence and severity score than many popular sports, including basketball, sailing, or soccer [3]. However, these numbers originate from the UK and Germany, which have a different climbing environment than Switzerland.

The increasing public interest in climbing injuries over the last years prompted our institution to evaluate ways of achieving more effective prevention by evaluating potential risk factors. To the best of our knowledge, our case–control survey of acute climbing injuries is the first study of its kind in sports medicine literature.

Methods

Setting

Three emergency departments (EDs), one level I trauma centre and two regional hospitals.

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Case–control survey

All patients acutely injured from indoor or outdoor climbing and admitted to one of the three EDs between 1 June and 31 October 2008 were included. Patients with chronic overuse syndromes, intracranial bleeding, skull fractures, Glasgow Coma Score (GCS) of greater than 14 or persistent retrograde amnesia were excluded. Patients with concussion were included as long as their GCS was 15 and they were able to fully and coherently understand and answer the questions. No patients were interviewed twice or in the role as a control and patient.

Patients reporting climbing injuries or being admitted as climbing injuries by Emergency Medical Services were interviewed by final year medical students, working in the ED as a part of their training. Patients were interviewed after the injury at one of the three EDs, or, in cases that did not allow time for interview in the ED, during their hospital stay. A questionnaire incorporating nine potential risk factors was used. Noninjured climbers (controls) were prospectively interviewed during the same time period at different popular climbing spots, using the same questionnaire.

We defined nine primary outcome measures as possible risk markers, as they have been used in previous risk assessment studies [4]. The variables included patient/control characteristics (age, sex, and experience in climbing), behavioral aspects [readiness for risk (the readiness to take risks, which might be beyond ones' abilities to cope with), abstinence from alcohol or drugs while climbing, the duration of warm-up, knowledge of climbing route] and external conditions (level of climbing route; Fig. 1).

Fig. 1

Nine primary outcome measures:

Climber characteristics

(1) Age years
(a) 16–30
(b) 31–45
(c) 46–59
(d) >59

(2) Sex: male/female

(3) Years of experience in climbing:
(a) <1
(b) 1–10
(c) >10

Behavioural aspects
(4) Readiness for risk: VAS 1–10 (1 implying minimal risk and 10 maximum of risk)
(a) 1–3
(b) 4–6
(c) 7–10

(5) Abstinence from alcohol while climbing: yes/no

(6) Abstinence from drugs while climbing: yes/no

(7) Duration of warm-up:
(a) none
(b) 1–10 min
(c) >10 min

(8) Knowledge of climbing route:
(a) First ascent
(b) The route has already been taken two or more times in the past

External conditions
(9) Level of climbing route:
(a) ≤5b/VI-
(b) 5c – 6a/VI–VII
(d) ≥6b/VII

Possible risk factors. VAS, Visual Analogue Scale.

Ethical considerations

Participation in the study was voluntary and anonymous; confidentiality was granted. Data were collected, stored, analyzed and shared according to the ethical committee standards of the three hospitals.

Statistical analysis

To identify study groups based on various predictors, univariate logistic regression analysis was performed. Odds ratios (OR) with corresponding 95% confidence intervals (95% CI) were reported. For ordinal or metric variables, ORs were expressed as the ratio of the odds increasing the predictor one unit. A P value of less than 0.05 was considered as significant.

All evaluations were calculated with R version 2.7.0 [5].

Results

Study population

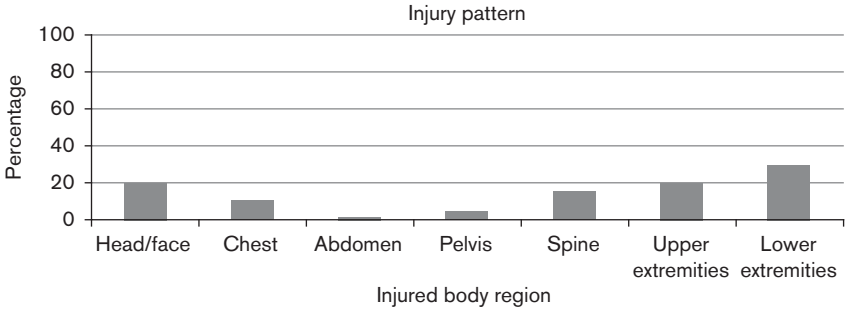
Fifty patients and 63 controls were interviewed. Seventy-six percent ($n = 38$) of patients and 67% ($n = 42$) of controls were male. The mean age was 34.2 years (range, 16–64 years) for patients and 31.3 years (range, 16–55 years) for controls. The median injury severity score was 8 (range, 1–48). Thirty-eight patients (76.0%) and 26 controls (41.2%) performed outdoor climbing and 12 patients (24.0%) and 37 controls (58.8%) performed indoor climbing. Most injuries affected the limbs, followed by head and face injuries and spinal trauma. Details are described in Fig. 2.

Logistic regression analysis shown in Table 1 demonstrated that the following variables were significant for patients: more than 10 years of climbing experience (vs. < 1 year of climbing experience), and no previous experiences of the climbing route. No statistical significance was detected for age, sex, level of difficulty of the climbing route, duration of warm-up, readiness for risk and abstinence from alcohol and drugs. Crude numbers of risk factor variables are described in Table 2.

Discussion

Reports on risk factors in climbing are rare and to the best of our knowledge, there have been no case–control studies on risk factors in climbing injuries, other than

Fig. 2



Climbers' injury pattern.

Table 1 Univariate logistic regression analysis

Variable	OR	95% CI	*P* value
Age	1.01	0.98–1.05	0.23
Sex	1.42	0.63–3.23	0.42
Readiness for risk	0.44	0.15–1.30	0.32
Abstinence from alcohol	0.42	0.04–4.13	0.63
Abstinence from drugs	0.85	0.14–5.30	1.00
Duration of warm-up (5–10 min vs. no warm-up)	1.06	0.44–2.33	0.902
Duration of warm-up (>10 min vs. no warm-up)	0.98	0.31–3.11	0.966
Level of climbing route (5c-6a/VI–VII vs. <5b/VI-)	0.81	0.31–2.14	0.675
Level of climbing route (>6b/VII vs. <5b/VI-)	0.94	0.38–2.31	0.893
Experience with climbing route (route taken for the first time vs. route taken for >2 times in the past)	2.72	1.15–6.39	0.022
Climbing experience (1–10 years vs. <1 year climbing experience)	2.23	0.71–6.97	0.167
Climbing experience (>10 years vs. <1 year climbing experience)	5.34	1.61–17.76	0.006

CI, confidence interval; OR, odds ratio.

Table 2 Crude numbers of risk factors in patients and controls

Variable	Number of patients	Missing	Number of controls	Missing
Age (16–30; 31–45; 46–59; >59 years)	24;20;4;2	0	35;19;9;0	0
Gender (male:female)	37;13	0	42;21	0
Readiness for risk (1–3; 4–6; 7–10 VAS)	13;19;9	9	14;27;22	0
Abstinence from alcohol	48	1	60	0
Abstinence from drugs	47	1	60	0
Duration of warm-up (none; <10 min; >10 min)	30;13;6	1	39;16;8	0
Level of climbing route (≤ 5b/V-; 5c–6a/VI–VII; ≥ 6b/VII)	16;13;19	2	19;19;24	1
Experience with climbing route (climbed route <2×; ≥2×)	29;18	3	29;34	0
Climbing experience (1;1–10; ≥10 years)	5;21;22	2	17;32;14	0

VAS, Visual Analogue Scale.

overuse syndromes [1,6,7]. We showed that a higher level of experience in climbing seems to be a risk factor for being injured. We observed the highest injury rate for climbers with more than 10 years of climbing experience. One explanation for this could be that dedicated climbers participate in different forms of climbing more often and therefore increase their cumulative injury risk [2]. A further explanation could be that more experienced climbers are used to manage dangerous situations easily and therefore underestimate the still inherent risk. Last but not least, more experienced climbers might suffer from more chronic overuse injuries and therefore also be more prone to acute injuries. It has also to be taken into account that patients with severe and fatal injuries have been excluded. We do not know whether these seriously injured patients were predominantly novice or very experienced climbers.

The lower interval of the variable 'experience in climbing' was intentionally as chosen as less than two times climbing a route, as the investigators believe that climbers climbing a route once only should not be classified as experienced.

We found no previous studies analysing the association of experience with the climbing route and injuries. This might be a risk factor, which has been previously overlooked. Age and sex showed no statistical significance between patients and controls and this finding is supported by a study on climbers in the UK [7].

The term 'readiness for risk' means the attitude to take risks, which might be beyond ones abilities to cope with. Therefore, climbers with smaller or greater climbing experience will rate their risk with respect to their personal abilities. The Visual Analogue Scale (VAS) is a widely used tool to rate emotions and feelings in clinical medicine and provide a good basis for assessments in this study. Readiness for risk seems not to correlate with injuries. However, after sustaining an accident, the reported readiness to take risk might be overestimated or underestimated. In contrast to other researchers who concluded that climbers under alcohol and drug influence account for more injuries, we could not find an association between reported alcohol and drug consumption and accidents [8].

Warm-up before climbing did not emerge as a protective factor in our analysis. Of course, this result does not imply that the warm-up should be omitted, as this study did not link the performance of warm-up with specific types of injuries.

Climbers attempting routes with increasing levels of difficulty are said to be more prone to acute injuries and overuse syndromes [7,9,10]. However, we found no association between injuries and the level of difficulty of the climbing route, which seems to be a key result of our study.

Limitations

To minimize sources of bias, patients with severe head or life-threatening injuries were excluded. Especially, as the rehabilitation process of these patients and their ability to answer a questionnaire varies widely, we decided to exclude these patients. The generalization of the study results is, therefore, limited by the examined patient population. The results that emerged as statistically significant did so only when seen as isolated factors and not in the context of the distribution of all other factors in the patient and control groups. Our study is limited in numbers of participants and represents a pilot project for understanding risk factors in climbing. Further investigations, including adjustment for suspected risk factors in multiple regression analysis, are needed to substantiate our results.

The numbers of outdoor and indoor climbers in the patient and control group were not equal. However, only risk factors affecting climbers in general and not particularly due to specific types of climbing were asked to minimize this source of bias. Although, patients with moderate-to-severe brain injury were excluded, 18 patients suffered from mild head trauma or injury to the face. Patients suffering from concussion were only interviewed if their GCS was 15, and they were able to answer the questions fully and coherently. Nevertheless, this subpopulation might be more influenced from recall bias than the rest of the study population. Questions on alcohol and drug consumption were answered by self-estimation and not on the observers own judgement and therefore might lead to reporting bias. The question on readiness for risk has been answered by self-estimation, which can cause recall and information bias. After an injury, patients may overestimate or underestimate their readiness for risk. The VAS for the readiness for risk has not been validated, and this may limit its value. In general, VAS investigations have been validated for emotions and 'feelings' in the past and the readiness to take risk is certainly classified among feelings [11]. Falls are regarded as 'normal' events during climbing, and therefore climbing training often focuses on the technique of falling and preventing injuries. What plays a major role in these falls is the competence of the rope partner to hold the falling climber. The questionnaire in this study did not address these aspects, but focused on the individual climber that suffered from an accident.

Conclusion

Climbers with higher experience seem to be more prone to injuries and therefore larger studies on this subgroup are warranted to show typical risk profiles and to develop preventive strategies. Not the level of difficulty of the route, but missing route experience seems to put climbers at risk. Hence, advice about the increased injury risk when trying new climbing routes and specific information about the route should be given in advance. In addition, physical, mental and technical preparations of climbers, as well as the role of the rope partner need further investigation.

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Conflicts of interest

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