The need for specific first aid and emergency knowledge whilst trekking in remote areas – results of the ADEMED (Aachen DEntal and MEDical) Expedition to the Annapurna region, Nepal

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A – the preparation of the research project
B – the assembly of data for the research undertaken
C – the conducting of statistical analysis
D – interpretation of results
E – manuscript preparation
F – literature review
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Abstract

Introduction: Fellow trekkers are often the first responders to their comrades in remote settings. Not everyone undertakes First Aid (FA) training when travelling to remote settings away from comprehensive healthcare, whether travelling independently or in a group. The syllabus of standard urbanised FA courses does not fully cover the needs of such trekkers (ie altitude illnesses). We evaluated the FA and emergency knowledge of trekkers en route in the remote Nepalese Himalayas.

Material and methods: A questionnaire about FA, trekking emergencies and water hygiene knowledge was completed by a cohort of 453 trekkers passing through Manang (3,519 m), Nepal, who volunteered their participation. A previously validated questionnaire consisted of 20 multiple choice questions (each using a five-point Likert scale) was used, followed by a subjective self-assessment of 17 key topics using a 5-point rating scale from very good to unsatisfactory knowledge. Demographic data including FA and climbing experience was also collected.

Results: The participants generally showed a poor knowledge in FA and trekking emergencies, even though 20.8% had some occupational medical training. In total 59.5% of possible answers were answered correctly. On average each participant managed to answer only one out of 20 questions (5.4%) completely correct. The most unsatisfactory results concerned the following topics, each with only 2.4% correct answers: hypothermia/resuscitation, rescue strategies and rip fractures. The best results were for HACE 33.8%, cranio-cerebral injury 33.6%, angina pectoris/heart attack 31.8% and hypovolemic shock 28.7%. The majority of participants had very limited experience of climbing mountains, rock climbing or ice climbing.

Conclusions: This study provides essential data identifying deficiencies in standard FA courses that are targeted for urban settings, and not for trekkers in a remote setting far away from comprehensive health care and rescue. There is a need to develop readily accessible FA curriculums specific to trekkers that would provide education on preventative care prior to, during, and after treks, and to improve their knowledge of medical care of trekking injuries and emergencies.

Keywords: trekking, emergencies, accidents, first aid, training

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Introduction

In an alpine environment with a perfect infrastructure for organised rescue services (i.e. Zermatt, Switzerland), the victim of any emergency will still need to survive for at least 30 minutes before rescuers arrive [1, 2]. During this waiting period he/she is completely dependent on the First Aid (FA) and rescue knowledge of their comrades. A previous investigation of climbers in the Western Alps found a significantly lacked knowledge in FA and in alpine emergencies [2]. Those results were subsequently used to improve specific FA training curriculums for Alpine mountaineers.

In contrast, remote trekking areas like the Annapurna Circuit in the Nepalese Himalayas have poor accessibility and a limited, or even missing, medical infrastructure. Therefore there is an even greater need for such hikers to be autonomous and efficient in FA in the event of an accident and in managing altitude illnesses. The recent Himalayan earthquakes in the trekking regions, whereby many trekkers became blocked somewhere on their trek – some of them injured by the earthquake – also emphasise the necessity for specific FA knowledge in this setting.

Compared with emergency situations in an urban environment, in alpine emergencies the delayed arrival of the emergency services and the characteristics of such emergencies are complicating factors. The time between the occurrence of the emergency and the arrival of rescue services – depending on weather conditions and accessibility of the area – must be bridged by comrades [2]. However, specific alpine disorders and emergencies are not covered by conventional FA courses which are designed for an urban environment and traffic. It is accepted that there must be differences among the curriculums for the many fields of emergency care FA training. Therefore, the present study evaluated the most applicable and relevant FA and emergency knowledge and skills that trekkers, already on the Annapurna Circuit, might need using a validated questionnaire and a questionnaire where they rated their self-perceived knowledge on the same topics. The ultimate aim was to identify any knowledge deficiencies to improve future FA courses specific to trekkers in the care of victims in remote settings.

Material and methods

All international trekking tourists aged 18+ years hiking the Annapurna Circuit that passed the study site were invited to join the study voluntarily (a prospective cohort study). The study site was based in Manang (3019 m), a six day trek from Besisahar (760 m), the preferred starting point of the circuit.

Based on a similar approach and aim described in detail in [2], the objective FA knowledge of trekkers was first assessed using a validated questionnaire (multiple choice, 5 answers per question, all of them might be correct or false, followed by a subjective, self-assessment questionnaire of the same 17 FA topics rating their knowledge. The former validated questionnaire that was used previously [2] was adapted slightly for this study to reflect trekking specific topics (i.e. water hygiene), and was offered in either English or German text. In total there were questions to 17 topics (Tab. 1). In a pilot study this questionnaire had been validated by a group of doctors trained in alpine medicine (course of the Austrian Society for Alpine Medicine [ÖGAHM], unpublished data). Based on these results some minor changes were made to avoid misinterpretation of questions or answers.

Table 1. Topics of the questionnaires

Topic	Number of questions
Hypothermia	2
Shock (hypovolaemic)	1
Acute Mountain Sickness (AMS)	1
Resuscitation	2
Frostbite	1
Cardiac emergencies	1
Head injuries	1
Fractures	1
Strategy / management of emergencies	1
Patient check	1
HACE (High Altitude Cerebral Edema) / HAPE (High Altitude Pulmonary Edema)	2
Water hygiene	1
Diseases en route	1
Heat stroke	1
Lightning	1
Snow blindness	1
Pain management	1

After completing the FA questionnaire, the participants rated their self-assessed knowledge for each of the 17 topics using a 5-point scoring system (1 = *very good* knowledge to 5 = *unsatisfactory* knowledge). Further demographic data acquired included personal data (age, sex, nationality, professional medical knowledge (medical student / physician / paramedic / nurse / mountain rescue team), FA training, mountain experience (defined by the number of stays over 3000 m per year as well as the total number of years of mountaineering), climbing ability (classified according to the UIAA Decimal Scale [3]), ice climbing expertise, whether one climbs with or without guides as well as at least basic information about the current project (trekking / expedition, organized by an operator or independently organized).

For evaluation descriptive statistical methods were used (number, minimum, maximum, median, average value, quartiles and standard errors of items of a given population). Data processing and evaluation was performed with dBASE IV (Ashton-Tate, Torrance, California) and SPSS V15 (SPSS Inc. Chicago IL, USA). Correlations were analyzed by Pearsons correlation coefficient (*r*). Differences between subgroups were analyzed with non-parametric tests (Mann Withney U-test). $P < 0.05$ was defined as significant.

The self-assessment was evaluated identically to a previous study [2]: Values 0-5 were converted into the scale values 0%, 20%, … to 100%. The same method was applied to the validated questionnaire for the five individual answers of each question, whereby 0% meant that to all five possibilities wrong answers were given, and 100% meant that all five possibilities were correctly answered. The difference between the two values demonstrated the deviation of the subjective self-perception of the volunteer's own knowledge against their objectively answered questionnaire results. A value of "0" (or close to) indicates the volunteer had assessed their knowledge to be almost ideal (= no deviation), while the extreme values close to 100% show a completely wrong self-perception. Minus 100% would indicate a miserable self-assessment whilst the results were very good and vice versa. The data were analyzed descriptively first, and then by subgroups compared using non-parametric tests. The study was approved by the ethical commission of Salzburg University (Austria).

Results

Collective

A total of 453/493 questionnaires were evaluated (return rate 93%) originating from 178 women (38.9%) and 275 (61.1%) men. The mean age of the collective was 34.4 (± 12) years. Men were significantly older than women (35.6 ± 12 yr. vs. 32.5 ± 11 yr; $P < 0.05$), and 75% of the collective was aged between 21 and 35 years old. The collective consisted of trekkers from 27 countries: 131 from Germany (28.7%); 63 UK (13.8%), 39 Netherlands (8.5%), 38 France (8.3%), 30 Israel (6.6%), 29 Czech Republic (6.3%), 24 USA (5.3%), 22 Canada (4.8%), and 17.3% from other countries.

A fifth (20.8%; 94/453) of our cohort had some occupational medical training comprising of paramedic or combat first responders or those with similar training in other countries (9.2%), 11.5% were physicians or medical students, and 57.4% (113 women; 147 men) were assigned to a FA course. A trekking related seminar or training of any type was stated by 85.2% (386/453) of the subjects. With respect to climbing experience, 16.3% (22 women; 52 men) stated they had completed a course in mountaineering, 49.9% (226/453) did not climb above 3000 m in the last few years, and 98% of the cohort had no experience in ice climbing or glacier hiking, with the remaining 2% represented exclusively by men. A significant 79.5% of all volunteers had no experience in rock climbing.

Questionnaire

The total collective provided a total of 59.5% (29,395 of 49,400) possible correct single answers (number of questions multiplied by five individual answers multiplied by number of participants). On average only one (5.4%) out of 20 questions was answered completely correctly per subject, which means that all five multiple choice options of the respective questions were answered correctly (Fig.1).

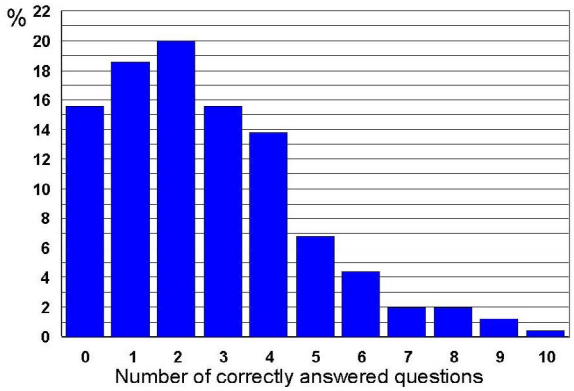

Figure 1. Percentage of completely correct answered questions on the questionnaire per participant (n = 453). No participant answered more than 10 questions completely correct

The question regarding High Altitude Cerebral Edema (HACE) was the most often correctly answered question (33.8%; 153/453), followed by the question about cerebral trauma which was correctly answered by 33.6% (152/453) of the cohort. The topic of "heart emergencies" was solved correctly by 31.8% of the subjects (144/453), followed by the "hypovolemic shock" question that was answered correctly by 28.7% (130/453) of the cohort. The most frequently incorrectly answered questions concerned the strategy or management of emergencies, hypothermia, and serial rib fractures (in each case only 2.4% (11/453) of the cohort answered correctly). The statements most often answered incorrectly are listed in Tab. 2.

Table 2. Questionnaire statements that were most often answered incorrectly (< 25% correct)

Statement	% correct answers
Hypothermic patients should not be carefully shifted	10.1
Patients with spinal trauma have a significant higher risk for hypothermia	9.5
Resuscitation: decreasing size of pupils indicates oxygen delivery to the brain and/or decrease of intracerebral pressure	18.4
In the case of severe hypothermia after a fall through a snow bridge into a creek a patient needs warmth to avoid further cooling	23.9
When a leg is broken, a careful and constant pull at the ancle normally decreases pain	21.7
Withdrawal with a patient needs more stamina and muscular power than if encountered in steep walls	11.9
Patients with rib fractures should be laid on the injured side	11.5

Since the acclimatization status and the underlying altitude profile was too different in the collective, the possible influence of high altitude hypoxia and acclimatization on the results was not analyzed.

Self-assessment

Most participants self-evaluated their overall knowledge as *satisfactory* (32.6%, mean score 3.53 +/−0.268). Only 2.4% estimated their knowledge as *very good*, and 14.5% as *good*. In contrast 27.3% evaluated their knowledge as *relatively bad* and 23.2% as *bad* (Fig. 2). In total the distribution of data shows an asymmetry towards skills judged significantly below average (Skewness −0.4414, Kurtosis −0.3495; mean absolute deviation 0.9564).

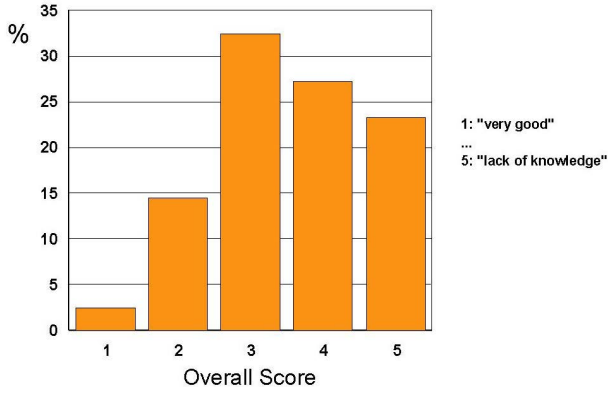

Figure 2. Overall rating of the self-assessment by the cohort on 17 topics

Self-assessment compared to objective results

The mean self-assessment deviates over −22.33 units from the ideally correct estimate, i.e. the self-assessment of the individual's self knowledge is worse than is objectively proven by the number of correctly answered questions in the questionnaire. The substantial mean variation as visualized in Figure 3 (Sx 36.57; median −25), and the skewness towards unsatisfactory knowledge are noticeable. An acceptable correct assessment (deviation between −10 and +10) of the individual knowledge was done for 14.8% and an acceptable rating (here defined as −25 to +25) for 40.1% of all ratings. However, 11.7% were unable to judge the level of their knowledge (< −75 or > +75) with 0.1% who overestimated their skills extremely while 11.6% underestimated them significantly.

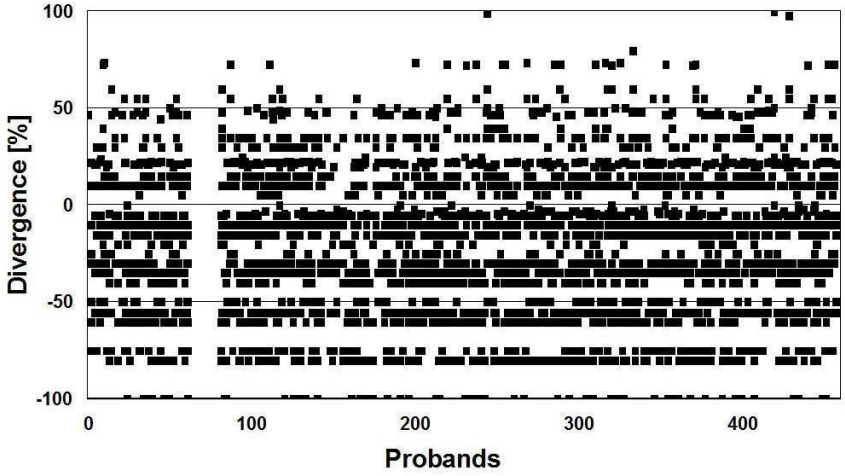

Figure 3. Distribution of the subjective self-assessment vs. objectively answered questions in the questionnaire. Values near zero indicate a realistic self-assessment, while those near 100 are significantly overestimated and −100 underestimated. The distribution of the dots follows normal distribution quite well

Discussion

The present study focuses its investigation on trekking travelers who went on classic, technically moderate routes, and crossed the village Manang in Nepal. About half (n = 235/453) of our participants were on an organized trekking tour, while the other half were on an independently organized cultural tour, which is comparable to the data of Luger et al. (2003) and Weichbold and Luger (2004). Since the actual social status, age and gender are important factors which have significant influence on risk management the social structure of our studies must be compared with care. Himalayas' tourists are typically university graduates aged over 30 years [4, 5]. Our findings were similar as the cohort's average age was 34.4 years, with 51.8% aged over 30 years, and 11.5% were physicians or medical students, which was also comparable to the previously referenced studies. In contrast, there were some differences to other collectives and studies. For example, in Urbas' investigation into trekker's self-perception of risks and dangers at high altitude, there was a slightly higher portion of males (69%) and the mean age was significantly higher (47 years) [6]. However in the investigation by Ziegler and Ulm [7], there was an significant higher number of women born between 1955 and 1964 (aged 45-54 years) and more people with higher education, among them some teachers, many physicians, social education workers and people in other social professions. This is similar to Keyes et al. whose collective showed a mean age of 48 years and 59% males [8]. According to the Nepal Tourism Board, in 2008 the largest number of visitors came from India (8,698), followed by Japan (2,502), the United Kingdom (1,784) and China (1,779). This differs to the distribution of nationalities in our study.

Burghofer et al. [9] came to the result that the existing FA training concepts have to be judged as insufficient as the examiners postulated "an early beginning of the training, a regular repetition of the training, as well as a sensitization for internal emergencies" being necessary. The present study supports this as an overall unsatisfactory knowledge in highly relevant FA topics was found. The topic hypothermia is an example of particularly relevant knowledge deficit in our cohort, especially as Küpper et al. [1] presented data on non-rapid onset alpine rescue missions – which should be the situation in almost any rescue of trekkers – whereby almost all of the emergency patients in the mountains suffered, more or less, from hypothermia. Another example is the topic of altitude diseases. Here Merrit et al. published similar results of inadequate FA knowledge [10].

An interesting result of the current study is that the question regarding Acute Mountain Sickness (AMS), a disease that occurs in 40-60% of all subjects in 4500 m [11], was answered correctly by only 13.8% of the cohort. Whereas the question about High Altitude Cerebral Edema (HACE), which occurs rarely (0.5 to 1% of all subjects in 4000-5000 m) [11], was answered correctly more often than those for AMS in the questionnaire (31% of the cohort). This indicates that there is no correlation between the need and any specific FA knowledge given – e.g. the occurrence of a problem and the ability to act adequately. Since this finding is the same than those in an earlier study with an identical question [2] it may be assumed that this is a systematical problem: Obviously people are more aware about unusual and impressive things – independent whether they are important in practice or not – than about ordinary topics.

There is also limited knowledge how to prevent severe cases. Vardy et al. showed that those individuals who suggested that the ascent should continue despite the occurrence of mild symptoms of altitude sickness were actually in danger of developing altitude sickness [12]. In this study the subjects had ascended significantly faster in the past 72 hours compared to those who had suggested postponement of the ascend and/or to descend after occurrence of AMS symptoms [12]. However Newcomb et al. showed that the majority of trekkers and carriers of the examined collective would recognize the symptoms of altitude sickness, and that most would respond with appropriate actions to avoid adverse consequences [13].

Travelers who had received information about AMS had significantly more knowledge about the symptoms and treatment of acute altitude sickness. However, only half of the travelers followed the preventive and curative advice offered by the hospital beforehand [14]. Medical consultation before the trip improves the knowledge of the travelers even though not all questions can be answered 100% correctly [15]. This favourably endorses the ultimate goals of the present study in wanting to equip the trekker with FA and emergency information that is directly relevant to the profile of their trip. However, logistically, financially and personally, the provision of such personal advice is difficult to implement. A more effective approach would be to target a group specific FA course with special focus given to prevention.

This is also supported for other situations and diagnoses by Tannvik's (2012) systematic review which assessed the FA provided by laypeople to trauma victims and to establish how often first aid is provided, if it is performed correctly, and its impact on outcome [16]. The proportion of patients who received first aid ranged from 10.7% to 65%. Incorrect first aid was given in up to 83.7% of cases, however the available evidence though sparse still confirms that the layperson with FA training is likely to have an effect on mortality in trauma – i.e. reducing it by 5.8% in one study [16].

There are also many mental barriers in potential participants to overcome before FA can be taught [17-21]. Furthermore it

seems that the willingness to participate in a training course is neither increased nor reduced if there is a personal risk for an increased need for FA [17].

Analytically speaking FA is the weak link in the rescue chain because the FA skills of fellow comrades must bridge the time needed before organized rescue systems arrive [22, 23]. In an European urban setting, this is about 7 to 12 minutes in most cases. The response time takes much longer in an alpine region e.g. in Zermatt, Switzerland, a region with a perfect infrastructure for helicopter rescue service. Here the injured person involved in a mountain accident emergency must wait on average for more than 30 minutes before the arrival of rescue services [1]. Trekkers in an environment with minimal, or no rescue infrastructure, must care for a patient much longer, sometimes even days. This strongly supports the need for trekkers having FA knowledge specific for such terrain. This has been also mentioned by other groups [24].

Another problem that arises is the loss of knowledge and practical skills over time. Medical staff tested 6 to 12 months after a resuscitation training showed a significant loss of knowledge, and interestingly this loss was more pronounced in practical rather than theoretical knowledge [25]. In an earlier study Spitzer found similar loss [26]. There are no comparable data about mountaineers or trekkers. However, it must be stated that regular refresher of specific FA training is a "must" [1, 21].

So far, current literature cannot be used to develop a specific FA training for trekkers [1, 21]. However, some recent research about other target groups in mountaineering sports (e.g. skiing, alpine mountaineers and climbers, via ferratas, etc. [1, 21, 27]) at least support the first steps to establish a concept of a specific training for trekkers. Some other factors must also be taken into account. Rescue techniques which were understood will be applied better than techniques which had to be memorized without any explanation [28, 29]. There are also time restrictions and therefore FA training for backpackers and trekkers should take no longer than 3 to 4 days (best if 2 to 3 days, or a weekend) [2]. Lindsey et al. suggested that the course contain a minimum extent of 64 hours plus a "resuscitation" module [30]. However, this time commitment appears unrealistic for most alpinists or trekkers [2]. Taking time restrictions into account, a refresher should be performed every three years and should require about one day. Even so it will be difficult to motivate the target group to do so [2, 25].

To train trekkers sufficiently in FA in a weekend seems optimistic. But if such training focuses on the important topics which are dangerous or occur often, it is well proven that it is possible to train lay persons to a surprising high level within a short time [21, 31, 32]. When taught using role training for one evening, participants were able to perform a check of a trauma patient within about two minutes only [32]. Complex practices will need to be simplified and schematized [33].

The main focus of FA training for trekkers should be on altitude diseases and on trauma [34-37]. However, some topics where lay persons fail most often include topics such as cerebral injuries, multiple injuries or polytrauma [2, 21].

The subjective feeling of competence depends on the state of training (repetition, revitalization of courses, and intensity of the training courses), the time period which elapsed since the last training, and on the age and on the sex of the FA trainee. It is a crucial factor to realize whether any further training is needed. However, there is no objective scale for this. Older adults and women estimated themselves more frequently as being less competent [38, 39]. Merrit reported that 51% of 100 travelers judged their skills regarding AMS as being "small" or "none" [10]. In that study the collective tended to underestimate their knowledge. The underestimation, the significant variance of the assessments, and the fact that only about 40% are able to give an acceptable rating, are all in accordance with the previous study on alpine mountaineers [2]. Küpper et al. reported that in their study the relationship between the self-perception rating of FA knowledge, and the results of the objective questionnaire, followed a normal distribution which indicated that the self-rating was a random result [2]. Although this was not the case in the present study, which used an identical approach, it showed a significant skewness of the distribution for any self-rating of knowledge as it was a weak indicator for the need of additional training. Therefore regular refresher training courses should be favored over any self-assessment.

Conclusions

FA knowledge of trekkers is not sufficient. Beside other factors this may be a consequence that normal "urban" FA training does not meet the needs of trekking emergencies. Therefore, specific FA training over a weekend and with refreshers one day every three years should be designed and offered to the interested public, e.g. via the local alpine clubs. Other than injury and trauma which are covered by "normal" FA training, the following topics should also be covered: altitude diseases, snow blindness, hypothermia, frostbite, lightning, pain management, and having a strategy on how to manage an emergency in the field. It is easy to train interested lay persons to a surprising high level of trekking-specific FA knowledge within a reasonable time.

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