BRIEF REPORT

Awareness of Altitude Sickness Among a Sample of Trekkers in Nepal

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Objective.—To quantify awareness of altitude sickness in a sample of trekkers in Nepal and identify strategies for increasing knowledge in that population.

Methods.—Sixty-five high-altitude trekkers were surveyed. Demographic data were gathered. Respondents were asked about their experience in high-altitude environments, and they answered clinical-vignette questions designed to test their abilities to recognize and identify treatments for common symptoms of altitude sickness. An altitude-awareness score was generated by tabulating correct answers to questions. Scores were correlated with demographic data.

Results.—Respondents who scored highest ($n = 8$) had significantly more experience in high-altitude environments, averaging 5 to 10 years ($P < .05$), and achieved higher average altitudes on their treks of 5171 m ($P < .05$) than did low scorers. Respondents with low scores ($n = 17$) trekked to an average altitude of 4138 m. Seventy-three percent wanted to learn more about altitude sickness, 30% said they would prefer to learn from the Internet, and 27% said they would ask a doctor.

Conclusion.—This study suggests that a large population of at-risk high-altitude travelers may be relatively naïve to the dangers of altitude sickness. Overall, respondents were interested in learning more about altitude sickness. Physicians and the Internet are the most attractive sources of information for this population.

Key words: high altitude, altitude sickness, travel

Introduction

Altitude sickness is a general term describing a heterogeneous group of disorders, ranging in severity from headache or disordered sleep to life-threatening pulmonary or cerebral edema. It is a common condition among travelers to altitude and may occur at heights as low as 1500 m (4921 feet).¹ Its incidence at moderate altitudes in the American West has been estimated at 18% to 66%,^{2,3} whereas in one series, 47% of trekkers flying to Lukla before ascending to Mt Everest base camp in the Khumbu region of Nepal (altitude of approximately 5200 m) were affected.⁴

The recent upsurge in outdoor recreation and adventure travel has exposed an unprecedented number of individuals each year to the dangers of high-altitude sickness. Millions of persons recreate annually in the American West, and popular destinations in Asia, South

America, and Africa receive hundreds of thousands of visitors each year. Travelers to such areas routinely exceed altitudes of 4000 m (13 124 feet) and in some cases can ascend to over 5000 m (16 404 feet).

Wider access to high-altitude destinations has led to a change in the characteristics of the travelers visiting them.⁵ No longer are the mountains the sole provenance of those with experience and expertise. Travelers to such areas today are frequently young, poorly equipped, and largely naïve to the dangers to which they expose themselves.

This study quantifies the extent of experience with and interest in altitude-related sickness among a sample of trekkers in Nepal. Questions were designed to identify how physicians might best educate such trekkers in order to limit mortality and morbidity caused by altitude sickness.

Methods

A survey was designed to learn more about knowledge of and attitudes toward altitude-related sickness in trekkers. It was applied to trekkers in Nepal because that

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Characteristics of trekkers by altitude-awareness score

	<10	10–14	>14
Percentile	≤15	16–84	≥85
No. of Respondents	17	40	8
Age*	23 ± 5.3	26 ± 2.9	26 ± 6.9
Male (%)	35	60	50
Home altitude (m)*	127 ± 265	373 ± 562	428 ± 1046
Achieved altitude	4138 ± 1286	4642 ± 967	5171 ± 906†
Experience (y)	1–5	1–5	5–10†
Days on expedition	20 ± 4.5	38 ± 39	49 ± 35
Ascents above 3048 m*	1.4 ± 1.0	3.0 ± 6.8	15.6 ± 34.1
Using medication (%)	12	20	13

*Expressed as an average ± SD experience range.

†Statistically significant difference when compared with low-scoring responders ($P < .05$).

country offered a high volume of mountain travelers, most of whom would be visiting the country to trek. Treks in Nepal are particularly appropriate to a study such as this because of their extremes of altitude and isolation.

A convenience sample of trekkers was approached in April 1999 while on the trail of the Annapurna trek, a popular route in western Nepal. Data were not collected regarding the number of days respondents had been on the trail. Trekkers were offered the chance to participate in the study, which was described as “a test of knowledge of altitude sicknesses.” Participants were excluded if they refused to take part or if they could not speak and read English. A written survey instrument consisting of a combination of multiple-choice and fill-in questions was administered to eligible subjects (Appendix). Data on response rate were not collected.

The survey identified demographic data such as age, nationality, and level of schooling. Data were collected about the altitude the respondents attained or would attain on their current trek. They answered questions about

their extent of experience in the outdoors and with extremes of altitude.

Respondents identified symptoms of altitude sickness in a series of multiple-choice questions. They picked actions and medications appropriate to a number of scenarios featuring altitude sickness. An “Altitude-Awareness Score” was computed based on their correct answers (maximum score = 20). Respondents were asked to estimate their risk of contracting altitude sickness or of dying in an avalanche while in Nepal. Finally, they were asked whether they were interested in learning more about altitude sickness and, if so, where they would seek such information.

Results were collated and analyzed by SAS software (SAS Inc, Cary, NC) upon our return to the United States. P values were calculated by a 2-sided Student's t test to compare demographic factors between the group in the top 15% and the group in the bottom 25% of altitude-awareness scores. Results with a P value less than .05 were considered to be significant. Averages are shown in the Table.

Figure 1. Frequency distribution of altitude attained among survey respondents.

Results

Sixty-five trekkers responded to our survey. Respondents represented 14 countries and were an average age of 25 years ($SD \pm 4.52$). Seventy-one percent ($n = 45$) had attained an educational level of college or graduate school, and 52% ($n = 34$) were men. In this sample, the average maximum altitude attained during a trek was 4582 m (14 900 feet) ($SD \pm 1082$ m), which was an altitude greater than that of any mountain in the lower 48 states of the United States (see the Figure for frequency distribution of altitude attained). Twenty percent ($n = 13$) reported being part of a group trek.

Respondents had varied understandings of altitude

sickness. Most (78%, $n = 51$) had heard of altitude sickness, but 75% ($n = 49$) were not aware of ever having experienced it themselves. The average altitude-awareness score in our sample was 10.95 ($SD \pm 3.03$).

Other answers were categorized regarding the altitude-awareness score. To give the study the greatest practical significance, we sought to identify differences that might exist between very highly knowledgeable respondents and others who were just "below average." To accomplish this, highly knowledgeable respondents were defined as those scoring in the top 15%, whereas less highly informed respondents were defined as those with scores in the bottom 25% (Table). Respondents with higher awareness scores tended to be older men who had more ascents above 3048 m (10 000 feet). High scorers had significantly more years of experience, averaging 5 to 10 years ($P < .05$), and achieved higher average altitudes on their treks of 5171 m ($P < .05$) than did low scorers. No association was between awareness scores and medication use on the trek.

In general, respondents' risk assessment was fair. Their average estimate of their chance of becoming ill with acute mountain sickness was 26% ($SD \pm 18.48$), correlating well with a real risk of 23% to 47%.² Respondents rated the danger of dying in an avalanche at 2.8% ($SD \pm 2.7$) as opposed to a real risk of just 0.0005% (5 in 1 million).

Respondents within the sample showed great interest in learning more about altitude sickness, with 73% ($n = 47$) saying they would seek more information. The source for information most often cited was the Internet, with 30% ($n = 20$) responding that they would learn through their computers. Twenty-seven percent ($n = 18$) said they would ask a doctor or other health care provider for information.

Discussion

The current worldwide popularity of outdoor recreation has put increasing numbers of persons at risk for the mortality and morbidity associated with high-altitude sickness. Although the literature has clearly delineated the dangers that extreme altitudes confer,⁶ few laypersons may have benefited from this information. In particular, many participants in high-altitude recreation, including trekkers, skiers, and mountaineers, may be relatively naïve to the dangers to which they expose themselves.⁷

The syndrome of altitude sickness is particularly amenable to a program of primary prevention. Although treatments for individuals with altitude sickness are effective, in many cases the remoteness of the individuals leaves them without care. The most advanced forms of

mountain sickness, high-altitude pulmonary edema and high-altitude cerebral edema, are difficult to treat and often are deadly.⁸ Altitude sickness is easily preventable.⁹ Medications such as Diamox (acetazolamide) and nifedipine and careful acclimatization can prevent altitude sickness in all but the most extreme circumstances.^{10,11}

This study, based on a small sample of trekkers, suggests that even basic skills of recognition and treatment of altitude sickness are absent in an at-risk population. This was true despite our sample's generally high level of education. Respondents were engaged in treks to the greatest extremes of altitude in the world, and most were aware of the existence of altitude sickness. Despite these facts, respondents underestimated their risk of falling ill by up to 50% and were unprepared to recognize or treat their symptoms if they did. Interestingly, this same population tended to overestimate their risk of dying in an avalanche (on average, a 5000-fold overestimation.) This may reflect the media's disproportionate coverage of avalanche deaths.

The population surveyed was interested in educating themselves more about the dangers of altitude sickness. This study suggests that a large population of outdoor enthusiasts would seek out and benefit from education about the dangers of altitude sickness. Education programs might decrease the mortality and morbidity associated with acute mountain sickness.¹² Such programs could be made available on the Internet or distributed through the offices of health care providers. A motivated and educated patient population such as the one sampled here might be able to make good use of resources that become available to them.

This study is limited by its small number of respondents. A larger study could more fully characterize the levels of awareness in a population of trekkers. Respondents were not asked about previous medical training, an important potential cofounder. This sample is also limited by the country in which it was taken. One does not need to demonstrate aptitude in outdoor skills to buy a trekking permit in Nepal, and no informational literature is provided to educate trekkers. Overall awareness might be greater if a population were sampled in a country that made tourist education a higher priority.

In addition, establishing the validity of a new survey is always difficult, and we did not explicitly test that in our study. However, respondents with high-altitude awareness scores tended to have greater experience in mountaineering. Conversely, younger and more inexperienced responders tended to have lower scores, lending the suggestion of validity to our measuring instrument.

Further work must also be done in effecting and measuring outcomes. A program focused on educating trav-

elers to the dangers of altitude sickness could be effective in improving knowledge.¹³ Increased awareness might also reduce mortality and morbidity associated with altitude sickness. Future interventional studies should focus on such topics.

Each year the press spotlights a daring rescue in which ill travelers are plucked from peril on some remote mountainside. Although such episodes make for appealing news copy, they are expensive and dangerous. Altitude-related sicknesses comprise only a small proportion of the risks that beset travelers, but they are prevalent and potentially fatal. It is time for physicians to educate their patients to the dangers associated with the extremes of altitude.

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Appendix Trekker Survey

This questionnaire is part of a medical study examining trekkers and acute mountain sickness (AMS). Responses are strictly confidential, and your time in answering this survey will hopefully result in minimizing the dangers of mountaineering. Thank you for your time.

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1. Age_____
 2. Nationality_____
 3. Gender: M/F
 4. What is your education level? (Circle one)
 - Precollege
 - Some college/university
 - College/university
 - Graduate study
 5. What elevation is your primary home at?
 - _____Feet OR _____Meters
 6. What is the maximum altitude you will/have attained on your trek?
 - _____Feet OR _____Meters
 7. Do you have access to the Internet at home?
 - Yes/No
 - 7a. What sports do you participate in? (Circle all that apply)

Hiking/camping	Climbing/mountaineering
Rock climbing	Ice climbing
Skiing/snowboarding	Orienteering
Kayaking	Running
Skydiving	Bicycling
Swimming/diving	Adventure travel
Other (specify)_____	
 - 7b. On average, how many total days do you spend on outdoor expeditions/trips in a year?_____
 8. What type of trek are you doing? (circle one)
 - Independent Guided
 9. How many years of climbing/trekking experience do you have?

Less than one	10–20
1–5	over 20
5–10	
 10. How many ascents have you done above 10 000 feet (3500 m)?_____
 11. Have you ever heard of acute mountain sickness (AMS)?
 - Yes/No
 12. If yes, how did you learn about it? (Circle all that apply)

Book	Magazine
Lecture	Health professional
Climbing guide	Climbing partner
The Internet	While buying gear
Television	
Wilderness first-aid course	
 13. Which of the following are symptoms of acute mountain sickness? (Circle all that apply)

Lightheadedness	Faintness	Weakness
Headache	Difficulty sleeping	Fever
Sick feeling	Loss of appetite	Vomiting
Stomach cramps	Stomach ache	Nausea
Poor balance	Dizziness	Difficulty breathing
Pain upon breathing	Shortness of breath	Dim vision
Physical exhaustion	Decreased urination	Nosebleeds
Poor coordination	Stuffy nose	Depression
Feeling of being hung-over		
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Appendix Trekker Survey

Continued.

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14. What is the lowest altitude at which acute mountain sickness can occur?
- 5000 feet (1500 m)
 - 10 000 feet (3000 m)
 - 15 000 feet (4500 m)
 - 20 000 feet (6000 m)
15. What contributes to acute mountain sickness? (Circle all that apply)
- Breathing cold air
 - Ascending too quickly
 - Ascending without supplemental oxygen
 - Overexertion
 - Malnutrition
 - Sleeping at high altitude
 - Respiratory infection
 - Dehydration
 - Poor physical fitness
16. Have you ever had acute mountain sickness (AMS)?
- Yes/No/I don't know
17. What percentage of trekkers in Nepal come down with AMS? _____ %
18. What percentage of trekkers in Nepal are killed by avalanches? _____ %
19. Can AMS be prevented? Yes/No
20. Can AMS be treated? Yes/No
21. If your trekking partner could not catch his/her breath while resting, what would be the first thing to do? (Circle one)
- Send the partner down alone
 - Take the climber down in a group
 - Continue climbing
 - Let him/her rest alone in camp
 - Rest a day with him/her in camp
 - Give more fluids
22. What drug might provide the best treatment for him/her?
- None
 - Acetazolamide (Diamox)
 - Lasix (furoseamide)
 - Dexamethasone (Decadron)
 - Sleeping pills
 - Maalox or Roloids
 - Codeine
 - Tylenol (acetaminophen)
 - Aspirin
23. If your climbing partner had a moderate headache and difficulty sleeping, what would be the best treatment?
- Send the partner down alone
 - Take the climber down in a group
 - Continue climbing
 - Let him/her rest alone in camp
 - Rest a day with him/her in camp
 - Give more fluids
24. What medication might be the best treatment for him/her?
- Acetazolamide (Diamox)
 - Lasix (furoseamide)
 - Dexamethasone (Decadron)
 - Sleeping pills
 - Maalox or Roloids
 - Codeine
 - Tylenol (acetaminophen)
 - Aspirin
-

Appendix
Trekker Survey

Continued.

25. If your climbing partner had a severe headache and poor balance, what would be the best treatment?

- Send the partner down alone
- Take the climber down in a group
- Continue climbing
- Let him/her rest alone in camp
- Rest a day with him/her in camp
- Give more fluids

26. What medication might provide the best treatment for him/her?

- Acetazolamide (Diamox)
- Maalox or Roloids
- Codeine
- Tylenol (acetaminophen)
- Aspirin
- Lasix (furoseamide)
- Dexamethasone
- Sleeping pills

27. Have you ever taken medications to relieve the symptoms of acute mountain sickness?

Yes/No

28. What did you take?_____

29. How did you learn about the use of this medication? (Circle all that apply)

- Book
- Magazine
- Television
- Lecture
- Health professional (doctor, nurse, pharmacist)
- Climbing guide
- Climbing partner
- Moutaineering-oriented first-aid course
- The Internet
- While buying gear
- Other (specify)_____

30. Do you want to learn about acute mountain sickness?

Yes/No

31. From what source would you seek information? (Circle all that apply)

- Book
- Magazine
- Television
- Lecture
- Health professional (doctor, nurse, pharmacist)
- Climbing guide
- Climbing partner
- Moutaineering-oriented first-aid course
- The Internet
- While buying gear
- Other (specify)_____

Thank you for participating