

Can knowledge protect against acute mountain sickness?

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Abstract

Background Studies show that the well-prepared traveller is less likely to suffer travel related illness. This study is designed to examine trekkers' knowledge of altitude sickness in an attempt to see whether knowledge can protect against acute mountain sickness (AMS) and high altitude pulmonary or cerebral oedema (HAPE/HACE).

Methods A convenience sample of 130 trekkers were interviewed in the Solu Khumbu region of Nepal. They were asked what action they would take firstly if they developed symptoms of AMS, and secondly, symptoms of HAPE/HACE whilst ascending. Options were to continue up, stay at the same altitude, descend or ask their guide.

Results With symptoms of moderate to severe AMS, 37 trekkers (28 per cent) indicated they would continue their ascent while 113 (72 per cent) would not. Those individuals who proposed continued ascent were significantly more likely to be suffering from symptoms of AMS ($p = 0.025$) and had ascended significantly more rapidly over the preceding 72 h ($p = 0.004$) than those who proposed to halt their ascent. With regard to symptoms of HAPE/HACE, 12 (9 per cent) indicated they would not descend, demonstrating no association with AMS ($p = 0.07$) or ascent in preceding 72 h ($p = 0.7$).

Conclusion Trekkers who indicated that they would act safely in the event of developing moderate to severe AMS were significantly less likely to be suffering from AMS when interviewed and had ascended significantly less altitude in the preceding 72 h being more likely to adhere to recommended ascent guidelines.

Keywords: acute mountain sickness, altitude sickness, ascent guidelines, knowledge

Introduction

Altitude illness commonly afflicts healthy men and women who go rapidly to altitude. It covers a spectrum of illness from the unpleasant, but relatively benign acute mountain sickness (AMS), to the potentially life threatening high altitude pulmonary oedema (HAPE) and high altitude cerebral oedema (HACE).¹

Symptoms of AMS include headache and one or more of dizziness or light headedness, insomnia, loss of appetite or nausea or vomiting and fatigue or weakness in the presence of a recent ascent to altitude. AMS is diagnosed and classed according to the widely accepted Lake Louise AMS assessment score.²

The correct action to take in case of developing AMS is to stay where you are and wait, then to descend if symptoms worsen or fail to improve.

Symptoms of HACE and HAPE are also diagnostic only in the presence of a recent ascent to altitude. HACE consists of either gait ataxia or mental state changes with symptoms of AMS, or both ataxia and mental state changes irrespective of symptoms of AMS. To diagnose HAPE, a subject must have at least two of the symptoms of dyspnoea at rest, cough, weakness/decreased exercise performance or chest tightness/congestion with at least two of the signs of crackles/wheezing, central cyanosis, tachypnoea or tachycardia. The only safe action to take in case of HAPE or HACE is to descend rapidly.¹

Guidelines exist to advise trekkers to restrict their ascent rates once over 2500 m in an attempt to decrease the likelihood of their developing symptoms of altitude illness. Current guidelines recommend limiting ascent to a maximum of 300 m a day whilst additionally taking one rest day for every 1000 m of altitude gained.^{2,3}

We asked trekkers how they thought they would respond in case of AMS or HAPE/HACE and compared their answers to their incidence of AMS, taking into account their rate of ascent. This was to fulfil the purpose of this study, namely to test trekkers' knowledge of AMS to determine whether the better-informed travellers did indeed have better health.

Materials and methods

Ethics approval

Ethics approval was obtained from the Medical Faculty Ethics Committee, Glasgow Royal Infirmary, (Reference – MF 02702).

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Subject selection

A convenience sample of 136 subjects were recruited of whom from teahouses along the old route to Everest Base Camp through the Solu Khumbu region of Nepal. Of these, 130 agreed to participate and 6 declined. The altitude of the teahouses varied between 2500 and 5180 m and interviews took place on 35 consecutive days in November and December 2003. To fulfil our inclusion criteria, trekkers had to be ascending, speak good English, have not consumed alcohol that day and not require emergency medical treatment.

Informed consent and confidentiality

Informed consent was obtained. Subjects were given an information sheet to read, and if willing to participate then the subject and researcher signed two consent forms, with one copy kept by each party. Confidentiality was maintained by ensuring all written records remained secure and no information was divulged except to a subject asking for their own results.

Proposed action questions

These were the questions asked to trekkers to ascertain the action that they proposed they would take if they developed symptoms of AMS or HAPE/HACE.

Question one

What would you do if you were ascending between two villages and you got a bad headache and felt off-colour? You are pretty sure its the altitude but everything else is okay.

This question is designed to simulate AMS.

Question two

What would you do if you were ascending between two villages and you got a terrible headache, started vomiting and shaking and felt short of breath? Again you are pretty sure its the altitude.

This question is designed to simulates HAPE/HACE.

Answers

Trekkers were given a selection of answers from which to choose. They could continue their ascent, stay at the same elevation, descend or ask their guide for advice.

Assessing the incidence of altitude sickness and ascent rates

A single observer calculated the Lake Louise score for each subject in the evening after arrival at the teahouse and the following morning before departure. Trekkers were also asked in which villages they had spent the last three nights so as to calculate the altitude they had gained over the preceding 72 h.

Statistical testing

Statistical analysis was performed using the following tests. χ^2 was used for two by two comparisons and correlation was used to demonstrate a relationship between two variables.

Where we wanted to look at a difference in samples we used a two sample test to compare means where the date was parametric and Mann–Whitney to compare sample medians where date was nonparametric. $p < 0.05$ was accepted as statistically significant for all tests.

Results

Incidence of AMS

Twenty-five per cent (37 subjects) had symptoms fulfilling the Lake Louise score for AMS at some point whilst they were involved in the study. The incidence of AMS varied greatly with altitude, 7 per cent affected below 4000 m and 37 per cent affected above 4000 m. The strong positive correlation between AMS and increasing altitude is well recognized and is confirmed in this study. Correlation, $p < 0.001$.

Question one

Question one was asked to ascertain the actions a subject would take if afflicted by AMS. Answers were categorized into 'safe' and 'imprudent'. 'Safe' answers include staying at the present altitude, descending or asking a guide for advice. Ninety-three trekkers (72 per cent) gave a safe answer. The 'imprudent' category includes those who said they would continue to ascend with severe AMS, this being a potentiality dangerous course of action. Thirty-seven trekkers (28 per cent) gave an 'imprudent' answer. These results are summarized in Table 1.

The relationship between the incidence of AMS and the answers given to question one are presented in Table 2. The group that gave a 'safe' answer were less likely to suffer from AMS than those who gave an 'imprudent' answer. χ^2 confirms the statistical significance of this finding. $\chi^2 = 4.996$, $df = 1$ and $p = 0.025$.

Question two

Question two was asked to ascertain the action a subject would take if afflicted by HAPE or HACE.

Table 1 Table showing answers to question one

Answer	N (%)
Continue the ascent up	37 (28)
Wait at present altitude	59 (45)
Go down	31 (24)
Ask guide for advice	3 (2)
Total	130

Table 2 Safe and imprudent answers to question one and acute mountain sickness (AMS)

Answer	Had AMS (%)	Did not have AMS (%)	Total (%)
Imprudent	12 (46)	25 (24)	37 (28)
Safe	14 (54)	79 (76)	93 (72)
Total	26	104	130

The answers to question two were also divided into 'safe' and 'imprudent' answers. The only safe action to take in case of HAPE or HACE is to descend as rapidly as possible. 'Safe' answers therefore included descent or asking a guide for advice, whereas 'imprudent' answers included remaining at the same altitude or undertaking further ascent. One hundred and eighteen trekkers (91 per cent) gave a 'safe' answer, whereas 12 trekkers (9 per cent) gave an 'imprudent' answer, as summarized in Table 3.

The relationship between the answers to question two and the incidence of AMS among subjects is summarized in Table 4. No significant association is demonstrated between planned action in event of HAPE/HACE and affliction by AMS with the sample size in this study. $\chi^2 = 3.305$, $df = 1$ and $p = 0.07$.

Ascent rates

Too rapid an ascent is known to predispose to AMS, so guidelines have been drawn up in an effort to decrease the incidence of AMS. The guidelines recommend a maximum ascent of 900 m over 72 h.⁴ The average altitude subjects had ascended in the last 72 h was considered with regard for the answers given to question one, where giving an 'imprudent' answer was significantly associated with a higher incidence of AMS. The median altitude ascended in the preceding 72 h was greater at 960 m in the 'imprudent' answer group and 760 m in the 'safe' answer group. This difference is statistically significant, Mann–Whitney $p = 0.004$.

We can look more closely at high altitude group, those subjects interviewed above 4000 m who have a greater likelihood of developing AMS. In this cohort, the median ascent in the preceding 72 h was higher at 960 m in the 31 people (34 per cent) who gave an 'imprudent' answer to question one and 620 m in the 59 people (66 per cent) who gave a 'safe' answer. As in the complete group this difference is statistically significant among subjects above 4000 m. Mann–Whitney $p = 0.02$.

Table 3 Table showing the answers to question two from the 130 different subjects

Answer	N (%)
Continue the ascent up	3 (2)
Wait at present altitude	9 (7)
Go down	109 (84)
Ask guide for advice	9 (7)
Total	130

Table 4 Table safe and imprudent answers to question two and acute mountain sickness (AMS)

Answer	Had AMS1 (%)	Did not have AMS (%)	Total (%)
Imprudent	0 (0)	12 (12)	12 (9)
Safe	26 (100)	92 (88)	118 (91)
Total	26	104	130

With regard to question two where 91 per cent of trekkers gave a 'safe' answer, there is no significant difference in the altitude ascended in the past 72 h between the 'safe' and 'imprudent' answer groups with this sample size. Mann–Whitney $p = 0.7$.

Considering age as a confounding variable

It is possible that younger people, who are more prone to risk-taking behaviour, might be both less likely to obtain information about altitude-related illness or to disregard such information whilst also ascending at a faster rate than their older counterparts. This would create a spurious association between 'imprudent' answers and AMS? There was no difference in the average age of subjects answering either question one or two 'safely' or 'imprudently' (two sample t -test, $p = 0.28$, $p = 0.1$, respectively). Nor was there any difference in the average age of those who suffered AMS or not (two sample t -test, $p = 0.78$) or any correlation between age and altitude gained in the preceding 72 h (two sample t -test, $p = 0.9$).

Discussion

Main findings of this study

In this study, 28 per cent of subjects, including 34 per cent above 4000 m, indicated that they would continue their ascent if they developed symptoms of AMS. This is an unwise and potentially dangerous decision as their condition may deteriorate if they ascend with AMS. Likewise 9 per cent of trekkers interviewed indicated that they would not descend with signs and symptoms of HAPE/HACE, conditions that are immediately life threatening and warrant immediate descent if at all possible.¹

The median rate of ascent above 2500 m was 960 m in the preceding 72 h in the group that answered indicated that they would continue to ascend with symptoms of AMS. This compares poorly with both the recommended maximum of 900 m and the 'safe' answer cohort's 760 m over the same period.

No relationship was demonstrated between the action a subject would chose to take in case of developing HAPE or HACE and the incidence of AMS or the rate of ascent.

The incidence of AMS was 25 per cent in total and 37 per cent above 4000 m. This is in keeping with the incidence reported in the literature, and we would hope it indicates that we interviewed a fairly typical cohort of trekkers as far as incidence of AMS is concerned.⁵⁻⁷

What is already known on this topic

Trekkers may seek information either independently or from a third party. Good sources or information easily accessed by the individual are available both in guidebooks and on the Internet.

Commonly used guidebooks, the Lonely Planet⁸ and Rough Guides,⁹ both contain sections dedicated to AMS.

The Internet is a widely used resource. One hundred and twenty-six million Americans used the Internet in 2003, representing 63 per cent of all adult Americans. Of these 93 million had been online to obtain information on health.¹⁰ As of

14 July, 2005, a 'Google' search for 'altitude sickness' gave 299 000 hits. The first one being the Outdoor Action Guide to High Altitude supported by Princeton University,⁴ the second the High Altitude Medicine Guide supported by the Wilderness Society.³ Both are well respected, aimed at the general population and contain a comprehensive review of the aetiology, symptoms and treatment of AMS along with advice on limiting the rate of ascent at altitude to within recommended guidelines.

Additionally trekkers may obtain information from a third party. The literature demonstrates that before travelling from United Kingdom to high altitude many travellers do seek advice, the majority from their GP (69 per cent) and/or tour operator (68 per cent).¹¹ In a study of 552 travellers to Cusco, Peru (3360 m), 62 per cent claimed to always seek health advice before travelling. Of the information they had been given 23.4 per cent claimed to recall everything, 60.4 per cent most of the advice, 15.5 per cent, some and 0.6 per cent nothing.¹²

Once in the Himalaya, opportunities to obtain information are more limited. Guides have the potential to be an important source of health advice. However, they are usually drawn from the local population and have little training in first aid or emergency treatment of altitude sickness.¹³ Neither the Nepalese embassy or Foreign Commonwealth Office in London, nor the British Embassy in Kathmandu give any health advice.¹⁴⁻¹⁶ This reinforces the importance of obtaining information before leaving the United Kingdom.

Essential to AMS prevention is the recognition of symptoms, knowledge of appropriate treatment and the observation of guidelines that recommend trekkers limit their rate of ascent so as to lessen the probability of them suffering AMS.^{2,3}

What this study adds

The protective effect of knowledge and education on health is a recurring theme throughout public health. This study provides a very practical example of this principle at work. Answering the planned actions question on AMS in accordance with current guidelines was protective against AMS probably because this group also had a slower average rate of ascent.

This is an important finding as we demonstrated that the cohort of trekkers that chose to ascend with symptoms of AMS were significantly more likely to be suffering from symptoms of AMS when interviewed, a finding that persisted in those interviewed above 4000 m, where the incidence of AMS is higher. This probably related to the greater average ascent reported for this group.

Probably the same factors that cause a subject either to be ignorant of or to ignore the recommended guidelines for AMS will also relate to the observance of recommended guidelines for ascent. We considered the hypothesis that older trekkers might be more cautious and thus seek and retain more information and ascend more slowly, thus suffering a lower incidence of AMS. However we can demonstrate that age was not significantly related to either the answers given, ascent profiles or the incidence of AMS, thus excluding age as a confounding factor.

The importance of pretravel education is demonstrated in studies showing that the well-prepared traveller is less likely to suffer travel related illness, even after adjusting for variables that reflect a more cautious personality.¹⁷ This is further confirmed in this work where better education and understanding of AMS prevented trekkers from suffering altitude-related illness whilst trekking in the Nepali Himalaya.

Limitations of this study

It would be interesting to repeat this study with a larger sample size to both confirm the findings in regard to the relationship between the planned actions of trekkers answers and their incidence of AMS and to further consider the relationship to HAPE and HACE. No relationship was demonstrated between the action a subject would choose to take in case of developing HAPE or HACE and the incidence of AMS or the rate of ascent. This may be a true finding or may reflect the small sample size, as only 12 trekkers chose not to descend.

Integral to any future work would be further investigating the reasons that a sizeable proportion of trekkers demonstrated, either a lack of awareness or disregard of guidelines, for both treatment of AMS/HAPE/HACE and for the prevention of altitude-related illness by observation of recommended ascent rates.

We would hypothesize that trekkers who gave 'imprudent' answers must have been either unaware of the recommended action to take or else they chose to disregard this information. Neither of these possibilities appears satisfactory as information has been shown to be readily available to simply ignore what is essentially medical advice seems unlikely in the majority of cases.

This matter requires further investigation to consider how to improve information uptake of what information is available, its recall and practical application.

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