

PubMed
Included

ISSN 0973-2284

INDIAN JOURNAL OF OCCUPATIONAL & ENVIRONMENTAL MEDICINE

VOL. 17 NO. 1 JAN-APR 2013



IAOH

Official Publication of
Indian Association of Occupational Health



Wolters Kluwer
Health

Medknow

A pilot study on the prevalence of Acute Mountain Sickness at the Sikh pilgrimage of Hemkund Sahib in the Indian Himalayas

Abstract

Background: Hemkund Sahib is a popular pilgrimage located at 4,330 m in the Garhwal range of the Indian Himalayas. Many travelers to the region have observed pilgrims exhibiting Acute Mountain Sickness (AMS)-like symptoms. However, no systematic study on its prevalence at Hemkund has been conducted. **Materials and Methods:** We surveyed 25 adults. AMS rates were determined using a standard Lake Louise Score (LLS). Responses to questions related to awareness of AMS, the perceived difficulty of the trek, and physiological data including arterial oxygen saturation (SpO₂) and pulse rate, amongst others, were collected. **Results:** Overall prevalence of AMS was 28% (mild AMS 20%, severe AMS 8%). Borg Rating of Perceived Exertion (RPE) was 3.9/10. Water consumption for the 4-5 hour trek to Hemkund was only 0.9 L and 20% of pilgrims consumed no water at all. Nine pilgrims claimed to be aware of AMS although only one had taken prophylactic medication. SpO₂ was 82.2 ± 1.2% and pulse rate was 106.5 ± 2.9 bpm (mean ± SEM). There were no differences in non-LLS-related parameters when pilgrims were subdivided by presence or absence of AMS. **Conclusion:** This pilot study has, for the first time, documented the prevalence of AMS amongst pilgrims to Hemkund Sahib in the Indian Himalayas.

Key words: Acute Mountain Sickness, altitude physiology, Hemkund Sahib, pilgrimage

INTRODUCTION

Hemkund Sahib is a Sikh temple situated in the Garhwal Mountains of Uttarakhand in north India. It is a popular pilgrimage site for Sikhs located at an altitude of 4,330 m.^[1,2] Between the months of June and October each year this remote region of Uttarakhand becomes populated by over 150,000 pilgrims,^[3] most of whom travel from the plains of Punjab and a minority of whom travel from overseas.^[4]

To reach Hemkund Sahib, pilgrims must drive to the town of Govindghat (altitude 1,830 m) from where they must disembark and walk 14 km, ascending 1,220 m to the town of Ghangharia (altitude 3,050 m), also known as Govind Dham.

Typically, pilgrims will rest here for one night before continuing the onward journey to Hemkund early the next morning. Some pilgrims, however, choose to hike directly from Govindghat, ascending 2,500 m in a single day. The journey from Ghangharia to Hemkund is physically demanding, ascending 1,280 m over a path distance of 7 km. Overnight accommodation at Hemkund Sahib is not possible and, therefore, pilgrims only stay for approximately 2-4 hours before returning to either Ghangharia or directly to Govindghat.^[2]

For the majority of pilgrims, the pilgrimage will be one of the most physically demanding challenges of their lives. The pilgrimage to Hemkund will have them ascend 2,500 m to a maximum altitude of 4,330 m in just 1 or 2 days.^[2] Furthermore, in addition to the rapid ascent and difficult hike, many pilgrims are inadequately prepared for the climb and the effects of hypoxia at the higher altitudes. Almost all of the pilgrims that come to Hemkund are from Punjab and are, therefore, not accustomed to hiking in mountainous terrain.^[4]

Given the temple's high altitude, the physically demanding trek from Ghangharia to Hemkund, the 1-2 day, 2,500 m ascent from Govindghat to Hemkund, and the general lack of preparedness and knowledge regarding Acute Mountain Sickness (AMS) amongst pilgrims, it would be expected that the prevalence of AMS in the region be high. Indeed, anecdotal reports from travelers at Hemkund Sahib have observed many people with symptoms suggestive of AMS, such as severe dizziness,

Inderjeet S. Sahota, Nidhi S. Panwar¹
President, ¹Director of Development Research, Office of Development Research, A Thousand Metres Above Foundation, Surrey, British Columbia, Canada

For correspondence: Mr. Inderjeet S. Sahota, President, A Thousand Metres Above Foundation, 15177 83A Avenue, Surrey, British Columbia, V3S 8R9, Canada.
E-mail: isahota@athousandmetresabove.org

Access this article online

Website: www.ijoem.com

DOI:

10.4103/0019-5278.116366

Quick Response Code:



headache, and fatigue.^[5] To this date, however, no systematic study on the prevalence of AMS has been conducted at this popular pilgrimage. In this pilot study, we, therefore, conducted a small study on the prevalence of AMS at Hemkund and determined how larger future studies examining AMS could be conducted in the region.

MATERIALS AND METHODS

During this pilot study, we surveyed 25 subjects in the Hemkund Sahib complex at an altitude of 4,330 m. Surveys were conducted in Punjabi or Hindi by the authors of this paper. The survey included questions regarding the subjects' age, place of residence, Borg Rating of Perceived Exertion (Borg RPE), travel method to Hemkund Sahib, amount of water consumed during the trek, awareness of AMS, whether they took medication for AMS during the ascent, time since arrival at Hemkund Sahib, and Lake Louise AMS score.^[6] In addition, oxygen saturation (SpO₂) and pulse rate were recorded from the index finger using a Nonin GO₂ Model 9570 (Nonin Medical, Inc., Plymouth, MN, USA).

Informed consent was obtained from each subject and the study conformed to the principles outlined in the Declaration of Helsinki. Data were collected non-invasively during the pilgrimage which pilgrims would have undertaken regardless of whether the study was operating. Furthermore, other than data from the pulse oximeter, all data were collected using anonymous questionnaires.

All data are presented as mean \pm standard error. Statistical analyses were conducted using Systat Software SigmaPlot 12.

RESULTS

Subject characteristics

The average age of the subjects surveyed was 26.3 ± 1.8 years. All subjects permanently resided in towns or cities below 2,000 m. All but one of the subjects surveyed were from India (96%).

The trek to Hemkund

The average time between subjects arriving at Hemkund and conducting the survey was 99.4 ± 11.3 min.

We used the Borg CR10 Scale,^[7] which is a category-ratio version of the original Borg PRE with scores ranging from 0-10, to assess perceived difficulty of the ascent to Hemkund from Ghangharia. The average reported score for the trek from Ghangharia to Hemkund was 3.9, corresponding to a value of "somewhat hard" on the scale. Borg scores from our subjects ranged from 0-10. We observed a significant positive relationship between Borg score and age, such that older individuals reported higher scores ($R = 0.424$, $P < 0.05$). No other correlations were observed.

Most pilgrims (88%) traveled to Hemkund by foot, 8% travelled by horse, and 4% travelled by a combination of horse and foot. Interestingly, the three pilgrims (12%) that did not travel exclusively by foot reported Borg scores of 10, 10, and 8.

Of concern, the average water consumption for the 4-5 hour trek from Ghangharia to Hemkund was only 0.9 L. Of the 25 pilgrims surveyed, five (20%) consumed no water during the trek and 19 (76%) consumed 1 L or less.

Prevalence and awareness of AMS

From our small sample, seven subjects (28%) exhibited symptoms of AMS with Lake Louise AMS scores 3 or higher. Of these subjects, five (20%) were diagnosed as having mild AMS and two (8%) were diagnosed as having severe AMS. The lowest recorded AMS score was 0 and the highest was 11. There was no correlation between subjects' AMS scores and any of the other parameters recorded, including SpO₂ and pulse rate.

Of the 25 pilgrims surveyed, nine claimed to be aware of AMS (36%), although only one (4%) had taken medication to help prevent AMS before ascending to Hemkund. This pilgrim was the only pilgrim surveyed who resided outside of India and he had taken 100 mg of acetazolamide before ascending from Ghangharia. Therefore, no pilgrims from India possessed medication for AMS.

Physiological data

Arterial oxygen saturations and pulse rates were only available for 23 subjects. The average SpO₂ was $82.2 \pm 1.2\%$ and the average pulse rate was 106.5 ± 2.9 bpm. Neither the SpO₂ nor the pulse rate correlated with any other parameters.

Group comparisons

To compare data between groups, we further subdivided subjects by absence or presence of AMS. No differences were observed between groups in any of the parameters except the total AMS score, the headache component of the AMS score, and the sleep component of the AMS score. As groups were subdivided based on their AMS scores, these differences were expected.

DISCUSSION

General observations

The pilgrims at Hemkund Sahib are of all ages, from the very young traveling with their parents to the very old. The sheer dedication of the pilgrims to suffer through the physical challenge to reach the temple is a touching spectacle.^[4] Many pilgrims travel barefoot with little water, food, sleep, and without proper hiking gear. However, these measures are also a cause for concern. While talking to pilgrims, it became clear that most believed the pilgrimage, or *yatra*, as it is called in Punjabi, was meant to be something people must suffer

through in order to attain. This notion was particularly noted in young men who attempted the pilgrimage. Pushing themselves beyond their normal limit, coupled with the general lack of awareness regarding AMS, means pilgrims are increasing their risk of developing AMS.

There are no medical facilities available at Hemkund.^[4] Should pilgrims become ill or injured, they must travel back to Ghangharia where there is a small health post staffed by one or two physicians and a pharmacy. More recently, helicopters have become available to transport people between Govindghat and Ghangharia. Therefore, for more serious injuries, emergency helicopter transport by air to Govindghat and subsequently by road to nearby Joshimath-where larger hospital facilities exist-is possible.

For pilgrims with access to the internet, several websites^[5,8-10] related to the Hemkund Sahib *yatra* exist with ample information regarding the dangers of AMS and ways to help prevent it. The first author of this paper recently developed a webpage advising travelers about the dangers of altitude sickness at Hemkund.^[10] Given the limited internet connectivity across India, especially in rural regions where many of the pilgrims to Hemkund will travel from,^[14] it is likely that these websites will most frequently be visited by pilgrims traveling from overseas and Indians from urban centers. For those without internet access, finding easily accessible information regarding AMS at Hemkund is more difficult. No information regarding AMS is available in Ghangharia unless you actively seek it from a medical facility. Furthermore, although signboards exist along the route warning pilgrims not to litter, we observed no signboards that warned pilgrims about AMS. As many pilgrims stay at the Ghangharia Sikh temple overnight prior to ascending to Hemkund, it may be helpful to provide information regarding AMS both there and along the route.

Discussion of results

The results of our pilot study indicate that 28% of pilgrims who travel to Hemkund Sahib develop AMS. Given that most of our sample consisted of young people, however, it is likely that AMS rates are underreported as they are less likely to communicate whether they are unwell in front of their peers. Indeed, previous studies have shown much higher prevalence rates for individuals trekking at similar, or even lower, altitudes.^[12-14]

Individuals' SpO₂ levels were within the expected range when compared to previous studies examining travelers at similar altitudes.^[15,16] As the majority of pilgrims traveling to Hemkund Sahib are ethnically Punjabi, it is unlikely that they would have any genetic advantage in maintaining higher SpO₂ when trekking through the mountains; unlike, say, the Tibetan people in nearby Himachal Pradesh and Jammu and

Kashmir who possibly do.^[17] For this reason, no rationale exists for their SpO₂ values to be any higher than the majority of travelers (excluding those from high altitude environments) in the mountains.

Borg RPE scores were relatively low given the nature of the trek. It is possible that younger pilgrims described the trek as being easy even if they found it challenging. As the average age of our subjects was low, this would act to decrease our overall reported Borg score. Indeed, we found a significant correlation between Borg score and age, which may be due to a combination of our younger subjects being more physically fit and a tendency for older pilgrims to accurately describe how they perceived the trek.

Many subjects trekking to Hemkund Sahib view the pilgrimage as an act of devotion which requires some degree of suffering. As a result, the vast majority of pilgrims travel exclusively by foot. However, some of our subjects openly described to us that they consumed no water and slept very little (if at all) during their ascent to Hemkund. Indeed, the average reported water consumption was a mere 0.9 L. By comparison, many hiking specialists recommend anywhere between 2-3 L of water for a moderately strenuous hike and upwards of 3 L for a strenuous hike.^[18] It is unlikely that many pilgrims have traveled to high altitude before, unless they have visited Hemkund in previous years. Furthermore, only 36% of surveyed pilgrims claimed to be aware of AMS, although no test was performed to determine the extent of their knowledge regarding prevention and awareness of AMS. It is, therefore, possible that the number of people with a real understanding of AMS is significantly lower. Only one subject reported taking prophylactic medication for AMS. For those that do not take medication, it is generally recommended that people ascending to high altitude proceed slowly and drink lots of water.^[19,20] It is a cause for concern that many pilgrims at Hemkund, who have little experience climbing mountainous terrain, are pushing themselves hard to ascend such a great height, with very little water.

Limitations and future directions

This pilot study had several limitations which need to be addressed in future studies examining AMS at Hemkund Sahib. Firstly, as we were in the region for a short time, we were only able to sample a very small number of pilgrims. In the future, much larger numbers must be surveyed to determine more accurately what the prevalence rates of AMS are in the region. Secondly, the average age of pilgrims surveyed was low, so it is essential to survey people of other age groups to form a more representative sample. Thirdly, the average time between pilgrims arriving at Hemkund and having conducted the survey was approximately 100 minutes. Although some individuals may experience the symptoms of AMS before being surveyed, it is possible that others experienced AMS afterwards. In the

future, this could be addressed by conducting the survey on the trekking route on the outskirts of Ghangharia. As there is only one route for pilgrims to follow, setting up on the route means one could survey many pilgrims who are returning from Hemkund and ask whether they experienced any symptoms of AMS at all while at the temple. Doing so would also enable one to survey more pilgrims throughout the day opposed to spending precious time trekking up and down the mountain. Finally, for future studies, it may be important to make monthly visits to Hemkund Sahib throughout the trekking season as individuals from overseas tend not to travel throughout the season, but during specific months, such as July and August, when the weather is slightly warmer. With easier access to information regarding AMS, pilgrims from overseas may be better prepared for AMS, which could influence overall prevalence rates at Hemkund.

Although future studies could rectify some of the limitations of this pilot study, we feel this study is an important step in providing information regarding the prevalence of, awareness of and preparedness for AMS amongst pilgrims to Hemkund Sahib in the Indian Himalayas.

ACKNOWLEDGMENTS

The authors would like to thank the pilgrims at Hemkund Sahib who participated in this study.

REFERENCES

- Satrakar MK, Khare PV, Keny VL, Chhakchhuak V, Kasture MS, Shivagaje AJ, *et al.* Effect of light intensity on the oviposition rhythm of the altitudinal strains of *Drosophila ananassae*. *Chronobiol Int* 2007;24:21-30.
- Weare G. *Trekking in the Indian Himalaya*, 5th ed. Lonely Planet Publications Pty Ltd 2009.
- Shinde K. Pilgrimage and the Environment: Challenges in a Pilgrimage Centre. *Curr Issues Tour* 2007;10:343-65.
- Michaud H. *Walking in the footsteps of the Guru: Sikhs and seekers in the Indian Himalayas*. Calgary: Department of Anthropology, University of Calgary; 1998. Available from: <http://hdl.handle.net/1880/26373> [Last accessed on 2012 Jul 27].
- Sikhnet. Hemkunt Sahib-The Journey. Available from: <http://www.sikhnet.com/oldsikhnet/HemkuntSahib/journey.htm> [Last accessed on 2012 Jul 27].
- Sutton JR, Coates G, Houston CS. The lake louise consensus on the definition and quantification of altitude illness. *Hypoxia and Mountain Medicine*. Burlington: Queen City Printers; 1992.
- Borg G. Borg's Perceived exertion and pain scales. Champaign: Human Kinetics; 1998.
- Sikhnet. Pilgrimage and trekking in the Indian Himalayas. Available from: <http://fateh.sikhnet.com/hemkuntsahib/intro.htm> [Last accessed on 2012 Jul 27].
- India Hikes. Valley of Flowers and Hemkund Trek. Available from: <http://www.indiahikes.in/himalayan-treks/valley-of-flowers/> [Last accessed on 2012 Jul 27].
- Sahota IS. Important information for travellers to Hemkund Sahib. 2013. Available from: <http://athousandmetresabove.org/2013/04/02/amshemkund/> [Last accessed on 2013 Apr 9].
- Cecchini S, Scott C. Can information and communications technology applications contribute to poverty reduction? Lessons from rural India. *Inform Technol Dev* 2003;10:73-84.
- Maggiolini M, Buhler B, Walter M, Oelz O. Prevalence of acute mountain sickness in the Swiss Alps. *BMJ* 1990;301:853-5.
- Bloch J, Duplain H, Rimoldi SF, Stuber T, Kriemler S, Allemann Y, *et al.* Prevalence and time course of acute mountain sickness in older children and adolescents after rapid ascent to 3450 meters. *Pediatrics* 2009;123:1-5.
- Jackson SJ, Varley J, Sellers C, Josephs K, Codrington L, Duke G, *et al.* Incidence and predictors of acute mountain sickness among trekkers on Mount Kilimanjaro. *High Alt Med Biol* 2010;11:217-22.
- Basnyat B. High altitude cerebral and pulmonary edema. *Travel Med Infect Dis* 2005;3:199-211.
- Luks AM, Swenson ER. Pulse oximetry at high altitude. *High Alt Med Biol* 2011;12:109-19.
- Beall CM, Strohl KP, Blangero J, Williams-Blangero S, Decker MJ, Brittenham GM, *et al.* Quantitative genetic analysis of arterial oxygen saturation in Tibetan highlanders. *Hum Biol* 1997;69:597-604.
- Hoefs J. Hiking at higher elevations and water intake. *livestrong.com* 2011. Available from: <http://www.livestrong.com/article/466410-hiking-at-higher-elevations-and-water-intake/> [Last accessed on 2012 Jul 28].
- Hackett PH, Rennie D, Levine HD. The incidence, importance, and prophylaxis of acute mountain sickness. *Lancet* 1976;2:1149-55.
- Nerin MA, Palop J, Montano JA, Morandeira JR, Vazquez M. Acute mountain sickness: Influence of fluid intake. *Wilderness Environ Med* 2006;17:215-20.

Cite this article as: Sahota IS, Panwar NS. A pilot study on the prevalence of Acute Mountain Sickness at the Sikh pilgrimage of Hemkund Sahib in the Indian Himalayas. *Indian J Occup Environ Med* 2013;17:12-5.

Source of Support: Nil, **Conflict of Interest:** None declared.