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Field-testing at high-altitude

Recommendations from Leeds Metropolitan University's Himalayan 2011 research expedition team.

Extreme environments (e.g., heat, cold and altitude) are hostile and dangerous, challenging human physiological and psychological adaptive responses. With inadequate acclimatisation, extreme environments exert considerable stress on the body. The focus of this article is on high-altitude (>3,500 to 5,500 m), where environmental stressors include reduced availability of oxygen (hypoxia), low temperatures and humidity, and ultraviolet radiation, which may manifest as altitude-related illnesses.

Considerable individual variation in the physiological response to altitude make it difficult to predict who will develop altitude-related illness. With the rise in adventure tourism, it is now common for novice trekkers to travel to some of the world's highest regions (5,000 – 8,000 m). Reaching such heights requires a slow ascent to augment the physiological acclimatisation processes that enable the body to cope with the hypoxic environment. Field research offers the opportunity to monitor physiological and psychological changes, and gain a greater understanding of those changes, in the natural setting.

As sport and exercise scientists we are ideally placed to offer expert advice and scientific support to athletes travelling to altitude and to the novice/experienced high-altitude traveller. Our primary goals should focus on performance optimisation and health. The use of daily altitude exposure in a laboratory (normobaric or hypobaric intermittent hypoxia) has been shown to reduce the severity of acute mountain sickness (AMS) (Beidleman *et al.*, 2004) and improve the body's physiological responses to exercise and exercise performance at moderate altitude (Beidleman *et al.*, 2008). However, its potential to enhance exercise performance and well-being during a high-altitude expedition is controversial (Beidleman *et al.*, 2009). The Himalayan Research Expedition 2011 further explored this strategy in the high-altitude, field setting.

Himalayan Research Expedition 2011

Thirty-seven individuals (22 males and 15 females, aged 20-62 years) participated in the expedition. The management team included four mountain leaders (including authors DB and JK) and three doctors experienced in wilderness medicine. Three physiologists (authors AS, MG and LB) and two undergraduate students made up the research team. The expedition was led and managed by Dave Bunting MBE, who had successfully led several expeditions in Nepal, including an attempt of Everest via the West Ridge.

Planning, management and delivery tips

Where to go and when?

Expeditions are costly. The key to maximising success for both the participant and researcher depends on the time taken in the planning. When deciding the expedition location, consult your participants. With a consensus for climbing a peak, we chose Mera Peak (6,476 m) in the Everest Region of Nepal, for two reasons:

- It was relatively non-technical to cater for a range of mountaineering abilities
- It offered a slow ascent profile with an alternative (contingency) faster route.

Local knowledge

Local agents are an asset. They have contacts, knowledge of what can be purchased in country, the topography of the region and accessibility to testing sites. It is important to consider issues with language and the speed in which things happen in the developing world.

Timing and preparation for the new environment

We selected the autumn trekking season for the expedition; a period when the weather in Nepal is typically settled and clear, albeit cold. As people adapt differently to new environments, we scheduled a series of seminars to discuss health, hygiene, fitness, nutrition, hydration, equipment, local culture and physiological responses to altitude.

Costs

The cost of the expedition is only one part of the total cost for each individual. Ensure costs are fully transparent from the start, including:

- Specialist equipment and clothing
- Medical/travel insurance (extreme sports and appropriate altitude cover with helicopter evacuation is essential)
- Travel and accommodation
- Immunisations
- Expenses associated to research participation.

Consider the cost of transporting research, medical and specialist mountain equipment. Use participants' baggage allowances where feasible. Consider the purchase of equipment at destination (e.g., in Nepal a bespoke research tent was cheaper, reducing international freight costs). Hiring a generator proved invaluable. Budget for unexpected costs.

Health and hygiene

Health on the research expedition is the difference between success and failure. One sick person may jeopardise months of planning. To minimise health issues, team members should actively take responsibility for their health prior to and during the expedition, specifically:

- Immunisations
- GP visit for pre-existing medical conditions
- Hygiene (regular hand washing, anti-bacterial gel)
- Drink and eat regularly
- Personal first aid kit
- Protection from weather and environment
- Adequate rest
- Jetlag.

High-altitude regions are remote, isolated from medical resources and decision-making may be impaired.

Research

A close working relationship between the expedition leaders and the research team is imperative for a successful expedition and research outcome. Ensure leaders fully understand the research goals and the time required to achieve these goals. Leaders need to balance the safety and success of the expedition with the expectations of the participants as well as the research team. Schedule research testing on non-trekking days.

Ensure research assistants and participants understand the field-based research demands and are familiarised with testing protocols and equipment. For us, this included daily monitoring (pulse rate, oxygen saturation, fatigue, sleep quality and AMS

Above: Step testing at Tangnag, 4,200 m
Courtesy Richard Walker

score) plus three exercise testing sessions at 2,800 m, 4,200 m and 5,350 m. Research equipment needs to be robust, portable and easy to use. Carry spare equipment. Most scientific equipment is not rigorously tested outside of laboratory controlled conditions, which may compromise validity and reliability. Take the opportunity pre-expedition to validate or test equipment in a similar environment. Plan for times when equipment breaks or fails to function. Batteries rapidly lose charge in cold conditions so buy those better suited e.g., lithium, and wrap them in your sleeping bag/clothing when not in use.

Do not underestimate the fatigue factor at high-altitude. Testing achievable in one day in a laboratory may be unrealistic in the field at altitude. Double the time you estimate each test will take, factor in additional rest time, and plan a contingency should colleagues fall ill.

Take home message

Research at high altitude is physically and psychologically challenging. It is also immensely rewarding. With good planning and expedition management all team members successfully reached 5,300 m. This expedition proved it is possible to conduct good quality, high-altitude field research on a limited budget. However, the research would not have been possible without extensive goodwill and support from all expedition members and those who supported this endeavour. We recommend students and graduates embrace opportunities to participate in field research. And finally, when in the field "Take nothing but photographs, leave nothing but footprints." (anon) ■

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words:

Lisa Board is a Senior Lecturer in Sport and Exercise, University of Sunderland, a BASES accredited sport and exercise scientist and a PhD student at Leeds Metropolitan University. She was invited to submit this article as a winner of a BASES International Conference Grant.

The following contributors are all from Leeds Metropolitan University
Amanda Seims is a part-time lecturer and PhD student.
Max Garrard is a Senior Lecturer in Sport and Exercise.
Jason King is the Deputy Expedition Leader, Carnegie Great Outdoors.
Dave Bunting MBE is the Expedition Leader, Carnegie Great Outdoors.