

1 Title page

2 Title: A review of medical problems in Himalayan porters

3 Authors

4 1) \* Suvash Dawadi, MDGPEM, MBBS, DiMMNep, Mountain Medicine Society of  
5 Nepal (MMSN)/ CIWEC Hospital Pvt. Ltd, Kathmandu, Nepal email:  
6 suvashdawa@gmail.com Phone:+977-9841285742

7 2) Buddha Basnyat, MD, Oxford University, Clinical Research Unit-Nepal and Centre  
8 for Tropical Medicine and Global Health, University of Oxford, Oxford, United  
9 Kingdom and Nepal International Clinic, Kathmandu, Nepal email:  
10 buddhabasnyat@gmail.com Phone:+977-9851034187

11 3) Subarna Adhikari, MS Ortho, MBBS, DiMMNep, Mountain Medicine Society of  
12 Nepal (MMSN) email: justsubun@gmail.com Phone: +977-9851165789

13

14 Running title: Medical problems in Himalayan porters

15 \*Corresponding Author Suvash Dawadi, Mailing address: CIWEC Hospital Pvt. Ltd, GPO  
16 12895, Kathmandu, Nepal

17 Keywords: Himalayan porters, high altitude medicine, Nepalese

18

19

20

21

22 Authorship Confirmation Statement

23 SD: Concept, Manuscript preparation, Manuscript review

24 BB: Concept, Manuscript review

25 SA: Manuscript preparation, Manuscript review

26 We confirm that all coauthors have reviewed and approved of the manuscript prior to  
27 submission.

28 Author Disclosure Statements

29 SD, BB and SA declare no disclosures, conflict of interests or external funding.

30

31

32

33

34

35

36

37

38

39

40

## 41 Abstract

42 Porters have accompanied trekkers and climbers to high altitude since the earliest expeditions in  
43 the Himalayas. As the existing body of knowledge on high altitude medicine expands, the focus  
44 remains on trekkers or climbers and published literature on medical problems in the large porter  
45 population remains sparse. It is well known that porters working at high altitude in the Nepal  
46 Himalayas are often lowland dwellers and are as prone to high altitude illnesses like acute  
47 mountain sickness (AMS), high altitude pulmonary edema (HAPE) and high altitude cerebral  
48 edema (HACE) as the trekkers. Other illnesses like diarrhea, respiratory illnesses and infections  
49 also occur in this population. In this review, studies reporting these findings will be discussed  
50 along with the local context of socio-economic barriers to adequate healthcare for these porters.

51

52

53

54

55

56

57

58

59

60

61 A review of medical problems in Himalayan porters

62 Ever since the earliest expeditions adventurers sought to explore remote locations throughout the  
63 world enlisting the help of locals to carry the loads required. High altitude areas were not exempt.  
64 With the first foreigners setting foot in the Himalayas around 1907 (West 1989), a cycle of need  
65 was identified. The tourists needed to transport heavy equipment and food through tough terrain  
66 and the local population needed to earn money. Thus, started the porter- trekker relationship,  
67 both invaluable to each other. As the hikes and treks moved to higher elevations, there was  
68 recognition of illnesses related to high altitude. As years have passed, the knowledge about  
69 altitude illnesses in trekkers and mountaineers has steadily increased. In most of the studies  
70 examining medical problems at high altitude it is the tourist population that has been the focus  
71 of scientific work. The population who make travel to such extremes possible by carrying heavy  
72 loads, trudge along, seemingly unnoticed and neglected.

73 In this review we will focus on the porters in Nepal, a Himalayan nation famous for high altitude  
74 adventure activities. We will focus our discussion on porters from lowland regions trekking to  
75 high altitude regions on a seasonal basis.

76 In a poverty-stricken country like Nepal, where 55% of the population live below the  
77 international poverty line of US\$1.25 per day (Kalimili 2016), poor people originating from low-  
78 altitude areas may be drawn to work as a porter to supplement their subsistence farming and as a  
79 means for providing an education for their children. There are multiple health risks that are  
80 involved with working as a porter, especially at high altitude (Malville 2001, Bauer 2003, Doocy  
81 2007, Koirala 2018). The resurgence in tourist numbers after the 2015 earthquake means the  
82 numbers of porters going to high altitude will also have increased (van Strien 2018).

In a study of workload trends of 2 high-altitude clinics in Nepal, it was noted that around 40% of patients seen at Pheriche aid post are Nepalese and often porters. With limited education, improper clothing and equipment and very little knowledge of the potential medical problems, it has also been noted that most of these porters reaching altitudes of up to 5600m reside at lower altitude, and may not be well-suited for the hypoxia of high altitude and carrying loads in that environment (Basnyat 1999).

Coming from a low socioeconomic background and having to work as much as they can to earn enough, the health seeking behavior of these porters is noteworthy in that they only tend to visit health facilities once they become close to incapacitation. Most porters do not have any form of medical or evacuation insurance when they fall ill during their work. Nepali staff and porters are often reliant on the preparedness and resources of the trekking group to reduce the risk of medical problems. While helicopter evacuation for medical reasons is getting more accessible and often may happen for minor complains in tourists, the porters do not have easy access to medical evacuation (Dawadi, 2020).

In a recent survey among porters in the Khumbu by Koirala et al, the lack of knowledge about health issues among porters and how to tackle them at high altitude, carrying more than recommended loads, and financial pressure to complete a trip despite ongoing problems were highlighted. The study also emphasized some common medical problems faced by the porters, which included altitude illness, cough, trauma among others (Koirala 2018).

There have been other studies which focus on the biomechanics of load carrying and pulmonary physiology (Bastien 2005). Detailed studies on medical problems faced by the porters are limited. One study done in the Annapurna region highlights medical problems in both Nepali and foreign nationals in the route. They report fewer medical problems in the Nepali nationals

(porters and staff) compared to foreign tourists (Drew 2011). However, they also mention that this might reflect lower reporting of perceived problems in the porters as compared to trekkers. In the following section, we attempt to shed light on some illnesses encountered by porters in Nepal.

#### High altitude illnesses

Contrary to popular belief, all porters are not high-altitude dwellers. In fact, a large proportion of them live in low altitudes and only go to high altitude areas for work (Malville 2001, Koirala 2018, Newcomb 2011). Thus, they are predisposed to AMS on rapid ascent which they commonly do for financial gain. This is contrary to the local Sherpa porters who are known to be genetically better adapted to high altitude (Droma 2008). Studies looking at medical illnesses in porters and trekkers in the Manaslu region of Nepal, 8-12% of porters suffered from AMS (Basnyat 1997, Hillenbrand 2006). Another study done in the Khumbu reports a much higher (37%) rate of AMS in non-Sherpa porters at 4400m (Basnyat 2001a). Although studies about incidence of HAPE and HACE in porters are lacking, there are numerous case reports that highlight that these problems do indeed occur in porters. But, because of late reporting of symptoms, the sick porters usually present in extremis (Baniya 2017, Fagenholz 2007, Basnyat 1999). The Sherpa porters have now generally been replaced by other lowland ethnic groups like Rais, Limbus, Chhetris and Bahuns etc who are probably more predisposed to suffer from altitude-related problems. These porters are therefore at the same risk of altitude illness as a trekker would be (Basnyat 2001a). Lack of knowledge about the symptoms, prevention and reluctance to report any symptoms may account for the rate of altitude illness among porters (Newcombe 2011). In addition, mitral stenosis following rheumatic heart disease which is common in Nepal (Shrestha 1991, Shrestha 2012) may be asymptomatic at lower altitude but due

129 to pulmonary hypertension of high altitude, porters may present with pulmonary edema and may  
130 be misdiagnosed as HAPE (Hultgren 1992).

131 The fact that porters may also be equally at risk of altitude illness is very important for trekking  
132 groups, companies and tourists to recognize because there is often a false preconception that  
133 porters working at high altitude all hail from high altitude and are hence relatively immune to  
134 high altitude illness. It is paramount to realize that this is not the case and attention has to be  
135 given to the porters travelling with the expedition.

#### 136 Diarrhea

137 Acute diarrhea is by far the commonest illness occurring in travelers to Nepal (Pandey 2010).

138 The risk factors of poor hygiene, lack of water in high altitude locations, eating habits and not  
139 treating drinking water are at work not just for travelers but also for the porters. The local  
140 population also suffers from diarrheal diseases (Pokharel 2004). All studies that have looked at  
141 medical problems in porters, have mentioned gastroenteritis and diarrhea occur commonly.

142 However, the rates of diarrhea in porters was reported to be less than the trekkers travelling with  
143 them (Basnyat 1997, Drew 2011). Diarrheal illnesses can be very incapacitating for the porters  
144 and they may continue to carry heavy loads despite being dehydrated as they may not complain  
145 due to the fear of losing their job. In addition, because it is spread by fecal oral transmission,  
146 diarrhea may spread rapidly to other individuals in the traveling party.

#### 147 Other Infections:

148 Although high altitude trekking and climbing is an important attraction for tourists to Nepal, it is  
149 relevant to note that Nepal lies in the subtropical climate zone and various infections (like  
150 diarrhea as discussed above) are common in Nepal including vector borne diseases (Pokharel,

2004, Basnyat 2001b, Murdoch 2004). The porters as part of the local population share the same burden of infections, when they are at home and when they work. Apart from the very common gastrointestinal and respiratory infections, others such as enteric fever, dengue, typhus, viral hepatitis, influenza are also frequently encountered in those traveling to high altitudes (Basnyat 2001b, Amatya 2020). Finally, tuberculosis is a major public health problem in Nepal, with 44000 new cases reported in a year throughout the country, and nearly 10,000 cases still undiagnosed or unreported (National Tuberculosis Program Nepal Annual report 2073/74 (2017)). Cough in a porter may be due to tuberculosis and not the ubiquitous Khumbu cough.

#### Trauma/ Musculoskeletal injuries:

Wearing improper footwear and non-ergonomic load carrying can make trauma and musculoskeletal problems more frequent among porters. Carrying excess weight can lead to back problems and potentially makes the porters more prone to falls, resulting in injuries (Malville 2001). However, studies in the past have not shown increased orthopedic injuries in porters despite the heavy weights they carry (Basnyat 1997). A physiological study on commercial porters in Eastern Nepal concluded that they can carry extremely heavy loads without persistent medical problems because of their unique technique of self-paced, intermittent exercise (Malville 2001, Basnyat 2001c).

There has been a limit put on loads that porters are allowed to carry. However, monitoring is still difficult and often missing. Porters are usually paid according to the amount of load they carry and therefore there is always a motivation to carry more. The increased physical exertion can easily predispose the porter from the lowland to increased risk of altitude related illnesses.

#### Frostbite/ Cold injuries:



Although there is no formal data on the number of cases of frostbite among porters at high altitude, an assumption can be made that the rate is as high as in trekkers and climbers with almost 40-50 cases in a year in Nepal (SD Personal experience). A study done in neighboring Pakistan suggests high rates and poor prognosis of frostbite in porters. Improper gear, poverty, lack of knowledge on prevention or management, use of alcohol and colder accommodation are likely factors. (Hashmi 1998). The same factors apply in Nepal. The lowland porters are specially at risk as they may not be used to the cold, hypoxic environment, have improper gear (sandals and flipflops for footwear/ cotton or wool gloves) and are unaware of the symptoms and what to do in case of cold injuries. Hence frostbite cases in the local population which have been improperly managed by the patient or their friends are commonly seen. Frostbite can have devastating effects for porters. Proper medical treatment for frostbite is difficult to find in Nepal and when available may be expensive. Even when medical treatment is available most times the porters arrive late to the medical facilities and hence might not be candidates for thrombolysis or prostaglandin analogues (WMS Frostbite 2019). Those that do arrive in time may be unable to get treatment because of the high costs involved. Any loss of tissues for the porters can rob them of their income whether it is carrying loads or working in the fields. It is important to make sure that the porters have weather appropriate gear and knowledge about frostbite symptoms and first aid.

Other diseases: Uncorrected refractory errors, photokeratitis are more common in porters owing to lack of proper protective gear as well as reluctance to seek health advice (Gnyawali 2017, Basnyat 1997, Drew 2011). Gastritis, commonly known among locals as the “national disease of Nepal” is also well reported (Drew 2011).

With poor health seeking behavior being the norm among people from rural Nepal, other chronic and non-communicable diseases can also be expected to factor in the health of the porters, who are usually from poor socio-economic strata. Children working as porters experience a substantially increased risk of negative physical, emotional and educational outcomes due to their involvement in exploitive and dangerous work. Working as porters prevents access of children to education and in turn better employment, continuing the cycle of poverty in the long run (Doocy 2007).

**Mental Health:** Common mental disorders have been shown to be associated with poor socio-economic condition (Patel 2003). Working under stress away from their families in an inherently dangerous environment the porters might have some psychological issues. With mental illness still considered a taboo in Nepali society, manifestations of this at high altitude can be potentially problematic and often go unreported.

A study by Bauer et al, about the health of the Inca Trail Porters in Peru also highlights similar problems (back pain, fever, respiratory problems, stomach pain), with less altitude illnesses (Bauer 2003). Unlike the Inca trail porters who suffered from lack of clothing and equipment, the availability of cheap Chinese clothes and shoes has offset that problem to some degree in Nepal.

Organizations like Himalayan rescue Association (HRA, by providing free and/or inexpensive health care to porters in Khumbu and Manang) and International Porter's Protection group (IPPG; porters' shelters, health care, education) are working tirelessly to help improve the conditions of the Himalayan porters. The recent closure of the IPPG aid posts in the Gokyo Valley seems a backward step in porters' health. The aid posts catered to equal proportions of tourists and porters, and the porters got free treatment. The closure has the potential to leave

many porters' as well as locals without access to healthcare. This event has also brought into attention that ulterior motives may be at play undermining good work by these organizations.

However, it is clear that more needs to be done by the trekking companies and the government to enforce responsible trekking (Kupper and others 2012), ensuring proper treatment, compensation and health care for the backbone of the Nepalese tourism industry.

What can be done: Table 1

Conclusion: There is still a large void that needs to be filled when it comes to knowledge about medical problems in porters. Simple checklist documentation (for example frostbite incidence) of porter health problems by the existing high-altitude check-posts would be very helpful to figure out the extent of the problem. Basic requisites of education and better socio-economic status need to improve for better health status. Trekking agencies and groups need to understand and practice responsible trekking. Educating trekkers in porters' care and making them put pressure on trekking companies to guarantee porter care could be one way going forward. The UIAA recommendations on how to choose trekking companies can help trekkers make responsible decisions (Hillebrandt 2012). It is important to make sure health and evacuation insurance are in place for the porters and to provide regular first aid training. Pre-travel assessment of health status and optimization in case of chronic diseases might need to be prioritized. Porters are the cornerstone of any expedition and deserve to be cared for by their employer. It is the responsibility of the trekker or mountaineers to ensure this happens

References

1. Amatya, B Pandey, P., & Shrestha, S. K. 2020. An outbreak of influenza among trekkers in the Everest region of Nepal. *Journal of Travel Medicine*
2. Annual report 2073/74 (2017) National Tuberculosis Program Nepal. Kathmandu: National Tuberculosis Center; 2018 March. (148 p.) Available from:[https://nepalntp.gov.np/wp-content/uploads/2018/03/ Final-Annual-Report-NTPN-2018.pdf](https://nepalntp.gov.np/wp-content/uploads/2018/03/Final-Annual-Report-NTPN-2018.pdf)
3. Baniya, S., Holden, C. and Basnyat, B., 2017. Reentry High Altitude Pulmonary Edema in the Himalayas. *High altitude medicine & biology*, 18(4), pp.425-427.
4. Basnyat, B. and Litch, J.A., 1997. Medical problems of porters and trekkers in the Nepal Himalaya. *Wilderness & environmental medicine*, 8(2), pp.78-81.
5. Basnyat, B., Savard, G.K. and Zafren, K., 1999. Trends in the workload of the two high altitude aid posts in the Nepal Himalayas. *Journal of travel medicine*, 6(4), pp.217-222.
6. Basnyat, B. and Le Master, J., 2001a. Risk of altitude sickness in Nepalese porters in the Everest region. *J Inst Med*, 24, pp.137-143.
7. Basnyat, B., Cumbo, T.A. and Edelman, R., 2001b. Infections at high altitude. *Clinical infectious diseases*, pp.1887-1891.
8. Basnyat, B. and Schepens, B., 2001c. The burden of the Himalayan porter. *High altitude medicine & biology*, 2(2), pp.315-316.
9. Bastien, G.J., Schepens, B., Willems, P.A. and Heglund, N.C., 2005. Energetics of load carrying in Nepalese porters. *Science*, 308(5729), pp.1755-1755.
10. Bauer, I.L., 2003. Inca trail porters: the health of local tourism employees as a challenge for travel medicine. *Journal of travel medicine*, 10(2), pp.94-99.

11. Dawadi S., Pandey P., Pradhan R. 2020 Helicopter Evacuations in the Nepalese Himalayas (2016–2017), *Journal of Travel Medicine*, taz103,  
<https://doi.org/10.1093/jtm/taz103>
12. Doocy, S., Crawford, B., Boudreaux, C. and Wall, E., 2007. The risks and impacts of portering on the well-being of children in Nepal. *Journal of tropical pediatrics*, 53(3), pp.165-170.
13. Drew, C.M., Colleran, S., Zijp, M., Lama, L.P., Sherpa, N.J., Kelly, J.L., Sulzbach, N., Prior, D., Currin, S.A., Currin, S. and Nickol, A.H., 2011. Preparation and medical outcomes of Nepalese staff and porters compared with foreign nationals on the Annapurna trekking circuit. *High altitude medicine & biology*, 12(4), pp.349-356.
14. Droma, Y., Hanaoka, M., Basnyat, B., Arjyal, A., Neupane, P., Pandit, A., Sharma D., Ito M., Miwa N., Katsuyama Y., Ota, M. and Kubo K., 2008. Adaptation to high altitude in Sherpas: association with the insertion/deletion polymorphism in the Angiotensin-converting enzyme gene. *Wilderness & environmental medicine*, 19(1), 22-29
15. Fagenholz, P.J., Gutman, J.A., Murray, A.F. and Harris, N.S., 2007. Treatment of high altitude pulmonary edema at 4240 m in Nepal. *High altitude medicine & biology*, 8(2), pp.139-146.
16. Gnyawali, S., Shrestha, G., Khanal, S., Dennis, T., & Spencer, J. 2017. Ocular morbidity among porters at high altitudes. *Nepalese Journal of Ophthalmology*, 9(1), 30-36.
17. Hashmi, M.A., Rashid, M., Haleem, A., Bokhari, S.A. and Hussain, T., 1998. Frostbite: epidemiology at high altitude in the Karakoram mountains. *Annals of the Royal College of Surgeons of England*, 80(2), p.91.

18. Hillebrandt D., Gieseler U., Schöffl V., Küpper Th., 2012. How to Check the Quality of a Commercially Organized Trek or Expedition in OFFICIAL STANDARDS OF THE UIAA MEDICAL COMMISSION VOL: 7 Available from [https://www.theuiaa.org/documents/mountainmedicine/English\\_UIAA\\_MedCom\\_Rec\\_No\\_7\\_Check\\_Organization\\_2012\\_V2-3.pdf](https://www.theuiaa.org/documents/mountainmedicine/English_UIAA_MedCom_Rec_No_7_Check_Organization_2012_V2-3.pdf)
19. Hillenbrand, P., Pahari, A.K., Soon, Y., Subedi, D., Bajracharya, R., Gurung, P., Lal, B.K., Marahatta, R., Pradhan, S., Rai, D. and Sharma, S., 2006. Prevention of acute mountain sickness by acetazolamide in Nepali porters: a double-blind controlled trial. *Wilderness & environmental medicine*, 17(2), pp.87-93.
20. Hultgren, H.N., 1992. Effects of altitude upon cardiovascular diseases. *Journal of Wilderness Medicine*, 3(3), pp.301-308.
21. Kalimili, B.B.N. and Fantom, N.J., 2016. The little data book 2016. World development indicators.
22. Koirala, P., Wolpin, S.E. and Peterson, J.T., 2018. High Altitude Illness: Knowledge, Practice, and Attitudes of Porters in Nepal. *Wilderness & environmental medicine*, 29(4), pp.431-436.
23. Küpper, T., Hillebrandt, D., and Mason N. 2012 Medical and Commercial Ethics in Altitude Trekking *High Altitude Medicine & Biology* 2012 13:1, 1-2
24. Malville, N.J., Byrnes, W.C., Lim, H.A. and Basnyat, R., 2001. Commercial porters of eastern Nepal: Health status, physical work capacity, and energy expenditure. *American Journal of Human Biology: The Official Journal of the Human Biology Association*, 13(1), pp.44-56.

25. McIntosh, S.E., Freer, L., Grissom, C.K., Auerbach, P.S., Rodway, G.W., Cochran, A., Giesbrecht, G.G., McDevitt, M., Imray, C.H., Johnson, E.L. and Pandey, P., 2019. Wilderness Medical Society Practice Guidelines for the Prevention and Treatment of Frostbite: 2019 Update. *Wilderness & environmental medicine*.
26. Murdoch, D.R., Woods, C.W., Zimmerman, M.D., Dull, P.M., Belbase, R.H., Keenan, A.J., Scott, R.M., Basnyat, B., Archibald, L.K. and Reller, L.B., 2004. The etiology of febrile illness in adults presenting to Patan hospital in Kathmandu, Nepal. *The American journal of tropical medicine and hygiene*, 70(6), pp.670-675.
27. Newcomb, L., Sherpa, C., Nickol, A. and Windsor, J., 2011. A comparison of the incidence and understanding of altitude illness between porters and trekkers in the Solu Khumbu Region of Nepal. *Wilderness & environmental medicine*, 22(3), pp.197-201.
28. Pandey, P., Bodhidatta, L., Lewis, M., Murphy, H., Shlim, D.R., Cave, W., Rajah, R., Springer, M., Batchelor, T., Sornsakrin, S. and Mason, C.J., 2010. Travelers' diarrhea in Nepal: an update on the pathogens and antibiotic resistance. *Journal of travel medicine*, 18(2), pp.102-108.
29. Patel, V. and Kleinman, A., 2003. Poverty and common mental disorders in developing countries. *Bulletin of the World Health Organization*, 81, pp.609-615.
30. Pokhrel, D. and Viraraghavan, T., 2004. Diarrhoeal diseases in Nepal vis-à-vis water supply and sanitation status. *Journal of water and health*, 2(2), pp.71-81.
31. Shrestha U.K., Bhattarai T.N., Pandey M.R. 1991 Prevalence of rheumatic fever and rheumatic heart disease in school children in a rural community of the hill region of Nepal. *Indian Heart Journal*. Jan-Feb; 43(1):39-41.

- 326 32. Shrestha, N.R., Pilgrim, T., Karki, P., Bhandari, R., Basnet, S., Tiwari, S., Dhakal, S.S.  
327 and Urban, P., 2012. Rheumatic heart disease revisited: patterns of valvular involvement  
328 from a consecutive cohort in eastern Nepal. *Journal of cardiovascular medicine*, 13(11),  
329 pp.755-759.
- 330 33. van Strien, M. (2018), "Tourism Business Response to Multiple Natural and Human-  
331 Induced Stressors in Nepal", Neef, A. and Grayman, J. (Ed.) *The Tourism–Disaster–  
332 Conflict Nexus (Community, Environment and Disaster Risk Management, Vol. 19)*,  
333 Emerald Publishing Limited, pp. 87-104.
- 334 34. West, J.B. and Kellas, A.M., 1989. pioneer Himalayan physiologist and  
335 mountaineer. *Alpine J*, 90(94), pp.207-213.