Nepalese porters routinely carry head-supported loads exceeding their body weight \((M_b)\) for many kilometers up and down steep mountain footpaths at high altitudes. Except in African women \((1–3)\), virtually nothing is known about the energetic cost of carrying head-supported loads. We set out to determine the loads and distances carried by Nepalese porters, their metabolic cost for carrying the loads, and whether their optimal walking speed (as determined by the minimum cost for carrying a load) changed as a function of load.

The town of Namche (at an altitude of 3500 m) near Mount Everest hosts a weekly bazaar. Porters (Fig. 1A), predominantly ethnic Rai, Sherpa, or Tamang, typically take 7 to 9 days to travel to Namche from the Kathmandu bazaar. Porters (Fig. 1A), predominantly ethnic Rai, Sherpa, or Tamang, typically take 7 to 9 days to travel to Namche from the Kathmandu bazaar. Porters (Fig. 1A), predominantly ethnic Rai, Sherpa, or Tamang, typically take 7 to 9 days to travel to Namche from the Kathmandu bazaar.

The increase in metabolic power while carrying a load (the loaded oxygen consumption rate divided by the unloaded oxygen consumption rate at the same speed) as a function of the total weight \(M_{\text{tot}}\) (\(M_b\) plus the load) is shown in Fig. 1C for the Nepalese porters, control subjects (5), and African women \((I)\) at about the optimal speed. The Nepalese porters were far more economical than the control subjects at all loads and more economical than the African women at all except the lightest loads. Loads lighter than \(0.8\) to \(1.1\) m s\(^{-1}\) are carried “for free.” Above \(20\%\) of \(M_b\), the Nepalese porters’ advantage increases with increasing loads. The Nepalese porters’ economy allows them to carry loads that are on average \(30\%\) of \(M_b\) heavier than the maximum loads carried by the African women, for the same increase in metabolic rate.

The load versus speed versus energy-cost trade-off chosen by these porters is to walk slowly for many hours each day, take frequent rests, and carry the greatest loads possible. We observed, for example, a group of heavily loaded porters making slow headway up a steep ascent out of a river gorge. Following whistled commands from their leader, they would take up their loads and labor uphill for no more than \(15\) s at a time, followed by a \(45\)-s period of rest. Incredibly, this group of barefoot porters was headed for Tibet, across the Nanga glacier (altitude 5716 m), about another week’s travel beyond Namche.

So how do they do it? They might reduce the muscular work required to carry a load or increase their overall efficiency. The actual mechanism is unknown at this time.

References and Notes
4. Materials and methods are available as supporting material on Science Online.
6. We thank B. Banerjee of the Nepal International Clinic and Himalayan Rescue Association, M. Penta of the Université catholique de Louvain, and A. de Vinck for support.

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