Letters to the Editor

In Response to Metabolic Demand of Hiking in Wildland Firefighting by Sol et al

To the Editor:

We read “Metabolic demand of hiking in wildland firefighting” by Sol et al¹ with great interest. As recent events in California highlight, wildfires present a major environmental threat to large portions of the population, none more so than the dedicated firefighters who combat them. Continuing research to better understand the demands of firefighting and to maximize firefighter preparedness is essential. The findings reported by Sol et al address important elements of preparation by calculating estimated metabolic demands while hiking during training exercises and actual firefighting missions and comparing these to the previously estimated demand of the arduous pack test. The authors concluded that these data could be used to further refine work capacity testing for wildland firefighters. Although we agree that these data are the most robust available, we believe a few key factors were missing from the authors’ analysis and discussion.

The authors use the Pandolf equation to calculate estimated metabolic demand. Although the Pandolf equation has been validated at altitude, there is an upper limit of exercise intensity ($2.1 \text{ L} \cdot \text{min}^{-1}$) after which it may not be accurate.² Given an average weight of 82.9 kg among the firefighters in this study and reported energy expenditures up to $35 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, the Pandolf equation might not be reliable for maximal efforts at higher altitudes. Because the authors used a global positioning system to determine hiking grade and velocity, we presume that altitude data are also available, and we would be interested in further analysis on the effects of altitude on the factors reported.

The impact of smoke on energy expenditure and oxygen consumption is another important difference between firefighting deployments and training exercises. Although wildland fires do not usually lead to hypoxic conditions or critical levels of carbon monoxide in the surrounding environment in light of environmental mixing of air,³ that does not mean there is no impact on respiratory functioning. Studies have shown a decrease in forced expiratory volume in 1 s (FEV₁) after a single season of firefighting,⁴ as well as increased exposure to particulate matter and carbon monoxide.⁵ Importantly, the degree of exposure varies depending on crew assignment, which was not a variable included in the current analysis.

The authors state that the average energy expenditure during ingress hikes was similar to that required by the arduous pack test, but less than that demanded by training exercises. As part of the discussion, the authors posit that interagency hotshot crews may be preparing at an intensity designed to reflect the most taxing aspects of deployments.¹ Because these deployments differ by other environmental factors, such as altitude and smoke inhalation, that may impede performance, they must be included in any thoughtful discussion of preparedness.

Cara McAnaney, MD
Arun Ganti, MD, MPH

Department of Emergency Medicine, UCSF Fresno,
Fresno, CA

References

1. Sol JA, Ruby BC, Gaskill SE, Dumke CL, Domitrovich JW. Metabolic demand of hiking in wildland firefighting. *Wilderness Environ Med*. 2018;29(3):304–14.
2. Cymerman A, Pandolf KB, Young AJ, Maher JT. Energy expenditure during load carriage at high altitude. *J Appl Physiol Respir Environ Exerc Physiol*. 1981;51(1):14–8.
3. Alexander ME, Mutch RW, Davis KM, Bucks CM. Wildland fires: danger and survival. In: Auerbach PS, ed. *Wilderness Medicine*. 6th ed. Philadelphia, PA: Elsevier; 2012:240–79.
4. Black C, Tesfaigzi Y, Bassein JA, Miller LA. Wildfire smoke exposure and human health: significant gaps in research for a growing public health issue. *Environ Toxicol Pharmacol*. 2017;55:186–95.
5. Gaughan DM, Piacitelli CA, Chen BT, Law BF, Virji MA, Edwards NT, et al. Exposure and cross-shift lung function declines in wildland firefighters. *J Occup Environ Hyg*. 2014;11(9):591–603.

In Reply to Drs McAnaney and Ganti

To the Editor:

We thank Drs McAnaney and Ganti¹ for their interest in and attention to our recent publication in *Wilderness & Environmental Medicine*.² Their letter to the editor raised some important points. We appreciate the chance to address some of their concerns.

We agree that these data perhaps most accurately describe the energy cost of wildland firefighting. Not only did we collect data in the field on a wide range of crews,