A mouse or an elephant: what species fights infection more effectively?

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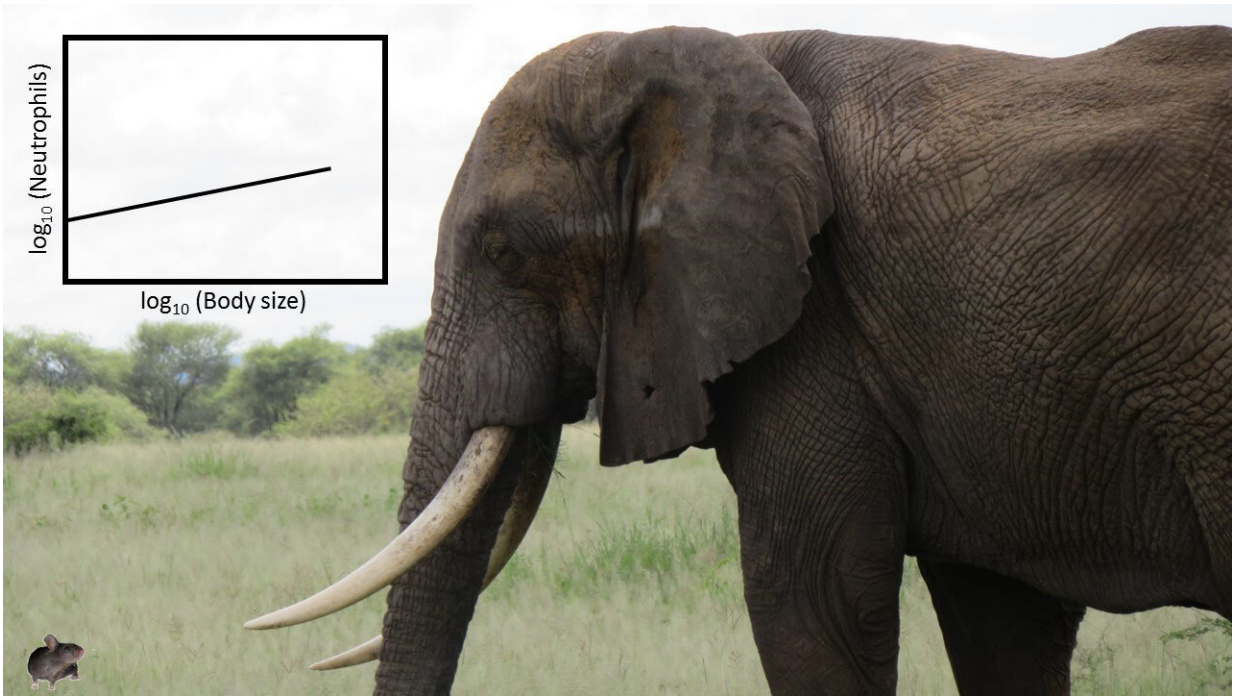

Large animals aren't immunologically small animals writ large. Some types of immune defenses are disproportionately greater in large mammals relative to small mammals. Credit: Cynthia J. Downs

What species is better at fighting an infection, a mouse or an elephant? Body size is one of the most noticeable differences among species, but relationships between immune defenses and body size have largely been unstudied.

Hamilton College Assistant Professor of Biology Cynthia J. Downs led a study with co-authors Ned Dochtermann (North Dakota State University), Kirk Klasing (University of California, Davis), Ray Ball (Eckerd College), and Lynn (Marty) Martin (University of South Florida) that investigated whether body mass was related to concentrations of two important immune cell types in the blood among hundreds of species of mammals ranging from tiny Jamaican fruit bats (~40 g) to giant killer whales (~5,600 kg). Their results appear in The Effects of Body Mass on Immune Cell Concentrations of Mammals, recently published online by The *American Naturalist.*

The researchers found that concentrations of lymphocytes, one type of white blood cell, didn't change in any special way with body size. That is, a mouse and an elephant have the same number of lymphocytes per ml of blood.

In contrast, big mammals had far, far more neutrophils in circulation than small species. Neutrophils are involved in early immune responses to many different kinds of invaders including bacteria and even bigger parasites such as worms.

The researchers speculate that larger mammals might need so many more circulating neutrophils to overcome the inherent advantage that infectious agents have over the animals they infect. This advantage arises because small things replicate their cells much faster than big things; to offset this benefit of being small, big things maintain a large pool of nasty cells to attack invaders.

This work shows that for some types of immune defenses, large and small mammals are fundamentally different. Downs and co-author Martin observed that this insight may help in developing better ways to link results from lab mice to improvements of human health as well as in enabling scientists to make predictions about the immune systems of

species never before studied. The co-authors speculate that these data could also even help wildlife managers predict how good a species could be as a host for a newly emerging disease.

More information: Cynthia J Downs et al. The effects of body mass on immune cell concentrations of mammals, *The American Naturalist* (2019). DOI: 10.1086/706235

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