To the iScience editors,

On behalf of my co-authors, I am submitting our manuscript “Costs and constraints of cellular immune activity during development in blue monkeys” for the exclusive consideration of iScience. We confirm that neither the manuscript nor any parts of its content are currently under consideration or published in another journal. All authors have approved the manuscript and agree with its submission to iScience.

Background: Activities of the immune system are energetically costly. During development, life history theory predicts that investments in immunity compete for limited available energy with other important physiological priorities like growth. Nevertheless, the prioritization of immunity vs. growth, and the energetic constraints on developing immune systems are poorly understood, particularly in wild animals in environments with limited resources.

This study: We evaluated the costs and constraints of cellular immune activity during development by combining biomarkers from 620 urine and 627 fecal samples of 41 wild, juvenile blue monkeys (M = 21, F = 20) collected over 8 months. We use mixed effects linear regression to evaluate the energetic consequences (i.e. energy balance, changes in estimated lean body mass) of elevated cellular immune activity (neopterin) at both monthly and shorter timescales, controlling for individual age, sex, and maternal rank. We then evaluated energetic constraints (i.e. energy balance, estimated lean body mass) on cellular immune activity, again controlling for individual attributes and additional social and ecological variables related to pathogen exposure. Lastly, we explored the role of HPA axis activity (glucocorticoids) in mediating energetic constraints on immune activity via its immunosuppressive effects.

Findings: Although cellular immune activity was unrelated to growth from month to month, activity hindered growth in the short term for juvenile blue monkeys. Further, immune activity was constrained by aspects of body condition, including energy balance and lean body mass. Body condition played a stronger role in levels of immune activity than other individual, ecological or social factors related to pathogen exposure. Constraints on immune activity were only weakly mediated by the immunosuppressive effects of glucocorticoids, which rise during development in this species when individuals are in states of low energy balance.

Significance: Our results suggest that cellular immune activity is both costly and limited by body condition in wild developing primates. Further, while immune activity may be prioritized over growth at acute timescales, growth from month to month appears unencumbered by investments in immunity. Energetic constraints on immune activity likely translate to restricted immune function during low energy balance. Our results are therefore valuable to identify potential threats to individual and population level health, relevant for the conservation of wild populations, particularly those in seasonal and resource poor environments and with a high proportion of immature individuals.

We expect that this article will speak to iScience’s broad audience, including readers with expertise in human and animal physiology, ecoimmunology, development, and conservation. We thank the editors in advance for their consideration of this work.

Sincerely,

Nic Thompson González, PhD